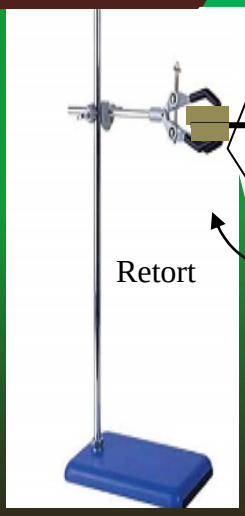
Physics Practical

Solved Question's for

Advanced Level

Form 5 &6



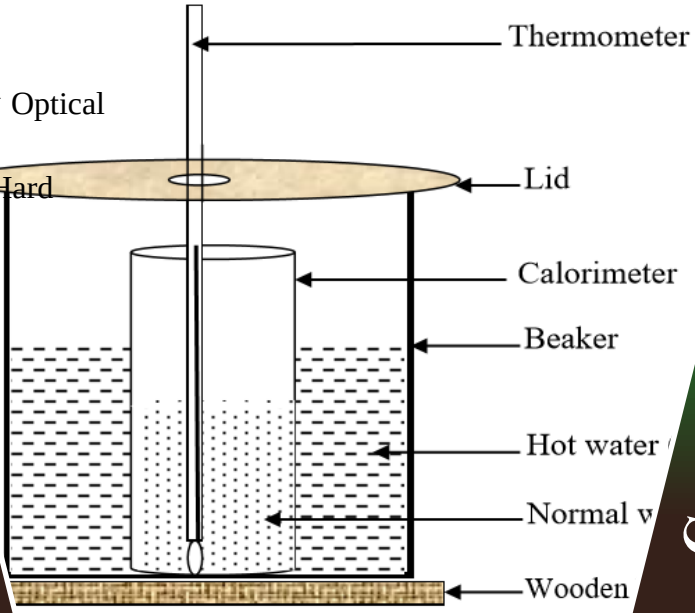


Figure 2

Current Electricity

Mechanics **HEAT** **NECTA 2018-2024**

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MECHANICS PRACTICAL

Question 04

The aim of experiment is to determine the value of acceleration due to gravity "g"
Proceed as follows

(a) Suspend a simple pendulum of length $L = 140cm$ .displace a pendulum through a small angle so as to make it to swing to and fro motion.

(b) Determine the time needed for 20 oscillations as (t)

(c) Reduce the length L of the pendulum by 20 cm each time and obtain a total of six readings.

(d) Repeat (c)times to find time taken for 20 oscillations so as to get the average (t).conduct the experiment as drawn below

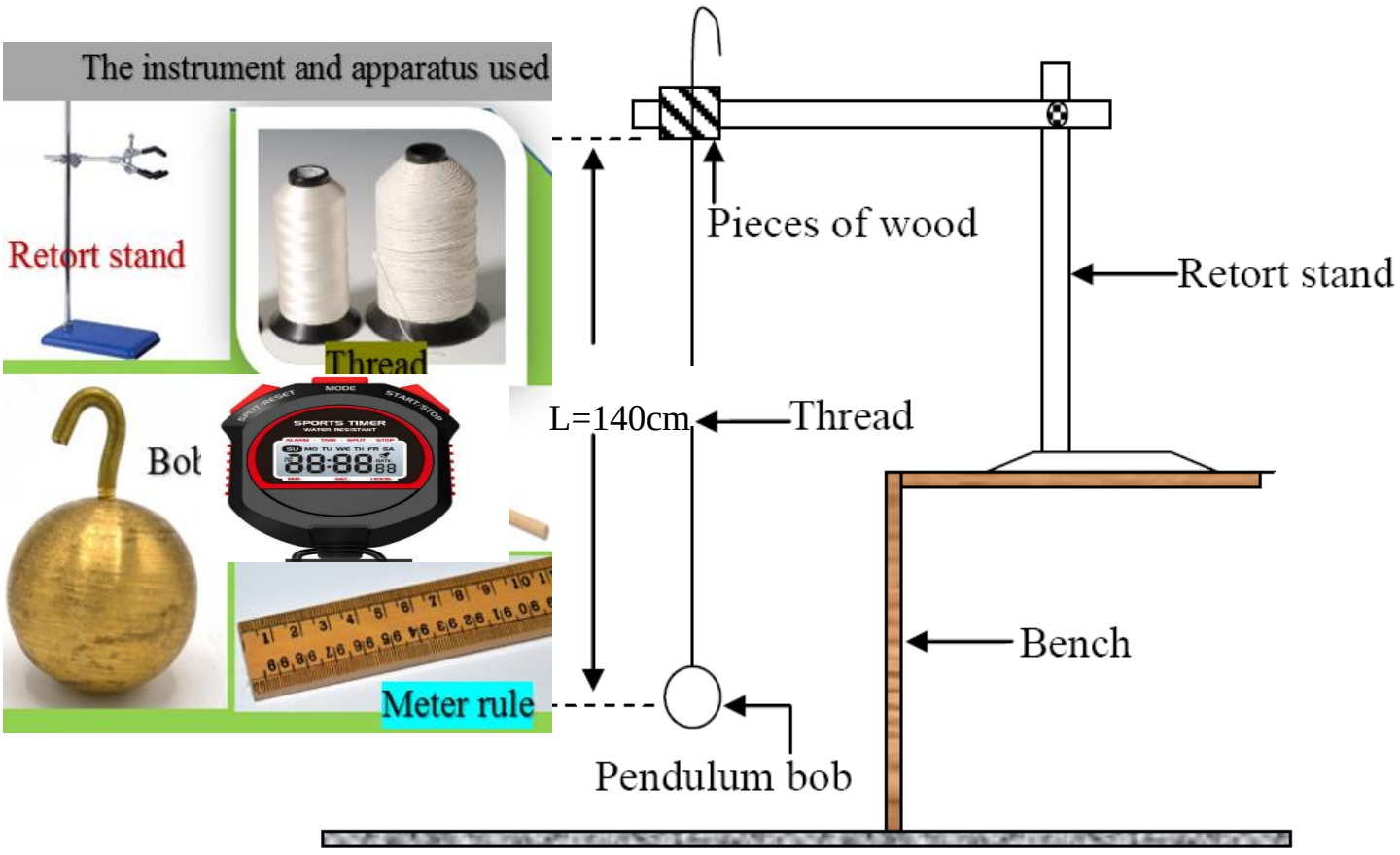


Figure 1

(a) Displace a pendulum bob to a small distance and release it such that, It begins to swing to and fro motion. Determine **Questions;**

(i) Construct a table of results that includes the values of T^2

(ii) Plot a graph of L (cm) against T^2 (sec^2)

(iii) From the graph determine the slope G

(iv) Calculate the acceleration due to gravity of the bob from the equation $T = 2\pi\sqrt{\frac{L}{g}}$

Solution for Question 01

Way to obtain data

From

$$T = 2\pi\sqrt{\frac{L}{g}}$$

For $L = 140cm \approx 1.4m, g = 9.86ms^{-2}$

Then

$$T = 2\pi\sqrt{\frac{1.4}{9.86}} = 2.36$$

$$t = T \times n, = 2.36 \times 20$$

$$t = 47.35s$$

For $L = 120cm \approx 1.2m, g = 9.86ms^{-2}$

Then

$$T = 2\pi\sqrt{\frac{1.2}{9.86}} = 2.19$$

$$t = T \times n, = 2.19 \times 20$$

$$t = 44.00s$$

For $L = 100cm \approx 1.0m, g = 9.86ms^{-2}$

Then

$$T = 2\pi\sqrt{\frac{1.0}{9.86}} = 2.00$$

$$t = T \times n, = 2.00 \times 20$$

$$t = 40.00s$$

For $L = 80cm \approx 0.8m, g = 9.86ms^{-2}$

Then

$$T = 2\pi\sqrt{\frac{0.8}{9.86}} = 1.79$$

$$t = T \times n, = 1.79 \times 20$$

$$t = 35.8s$$

For $L = 60cm \approx 0.6m, g = 9.86ms^{-2}$

Then

$$T = 2\pi\sqrt{\frac{0.6}{9.86}} = 1.55$$

$$t = T \times n, = 1.55 \times 20$$

$$t = 31.0s$$

For $L = 40cm \approx 0.4m, g = 9.86ms^{-2}$

Then

$$T = 2\pi\sqrt{\frac{0.4}{9.86}} = 1.3$$

$$t = T \times n, = 1.3 \times 20$$

$$t = 25.3s$$

practical report

(i) Table of results

Length, L(cm)	140	120	100	80	60	40
Time t_1(s)	47.35	44.02	40.00	36.00	29.40	25.00
Time t_2(s)	46.65	43.98	40.00	36.00	31.6	25.00
Average time t= $\frac{t_1+t_2}{2}$	47.00	44.00	40.00	36.00	31.00	25.00
Period T(s)	2.36	2.20	2.00	1.80	1.50	1.30
T^2 (s^2)	5.57	4.84	4.00	3.20	2.40	1.60

(iii) Slope from the graph

Slope S=$\frac{\Delta L(cm)}{\Delta T^2(s^2)}$

Point to from the graph A (2.0, 50) and B (4.4, 110)

S=$\frac{110-50}{4.4-2.0}\frac{(cm)}{(s^2)} = \frac{60}{2.4} = 25cm/s^2$

Slope (S) =$25cm/s^2$or $0.25m/s^2$

(iv) From the given relation T=$2\pi\sqrt{\frac{L}{g}}$

$$\mathbf{L} = \left(\frac{\mathbf{g}}{\mathbf{4\pi^2}}\right) \mathbf{T^2}$$

$$\uparrow \quad \uparrow \quad \uparrow$$

$$\mathbf{Y} = \mathbf{m} \quad \mathbf{x}$$

Thus

M=$(\frac{g}{4\pi^2})$ Where m is a slope

g=$(4\pi^2 M) = 4\pi^2 \times 25 = 985.9cm/s^2$

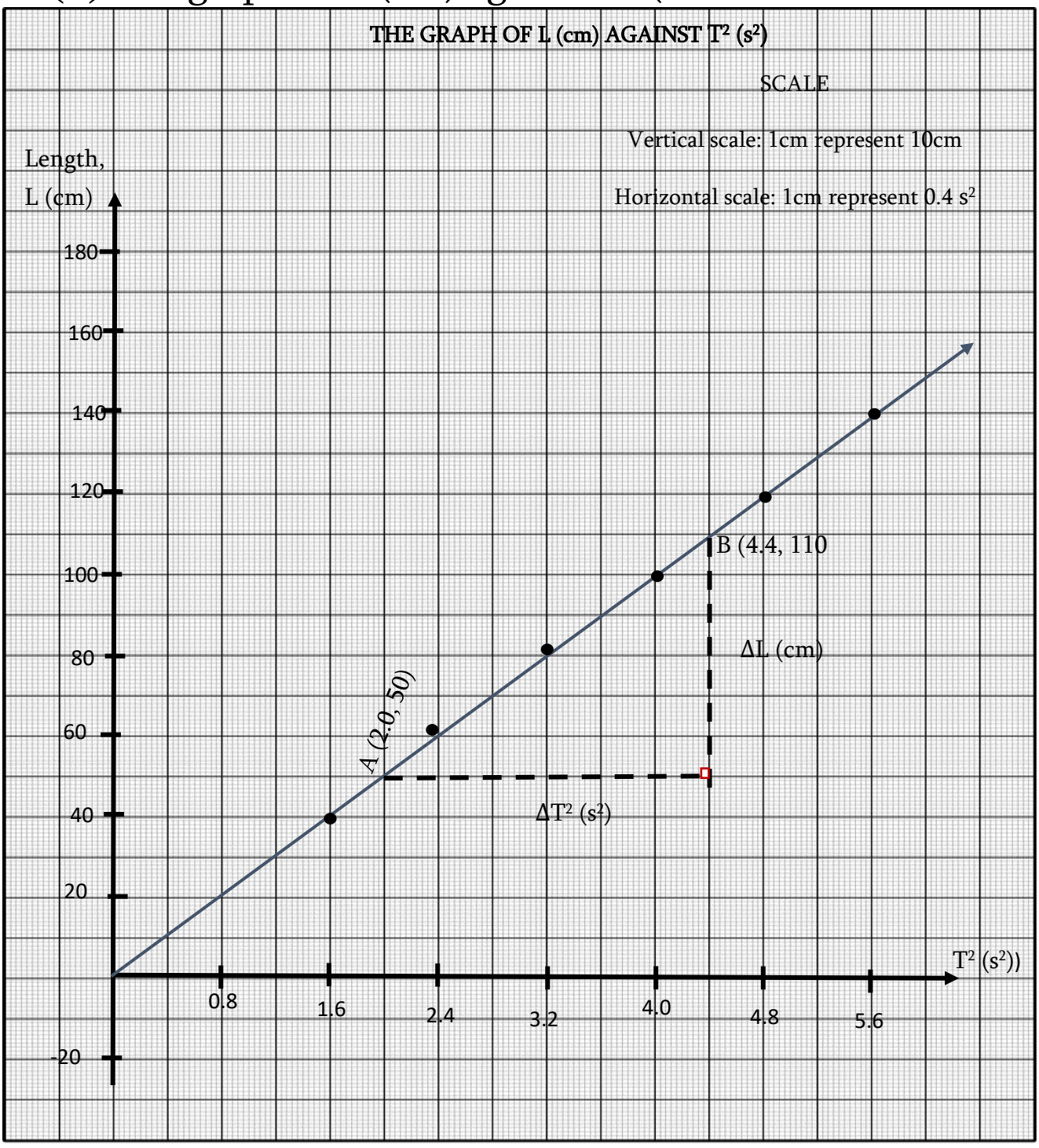
g=$985.9cm/s^2$ or $9.86m/s^2$

The value of acceleration due to gravity, g is $9.86m/s^2$

(v) The importance of acceleration due to gravity in daily life activities.

- ✓ it help to pull everything toward the centre of the earth's
- ✓ -it help people to walk
- ✓ -it help to know the depth of the ocean and the height of the mountain

(ii) The graph of L (cm) against T^2 (s^2)



Question 02

The aim of experiment was to determine the coefficient of rigidity of materials wire given

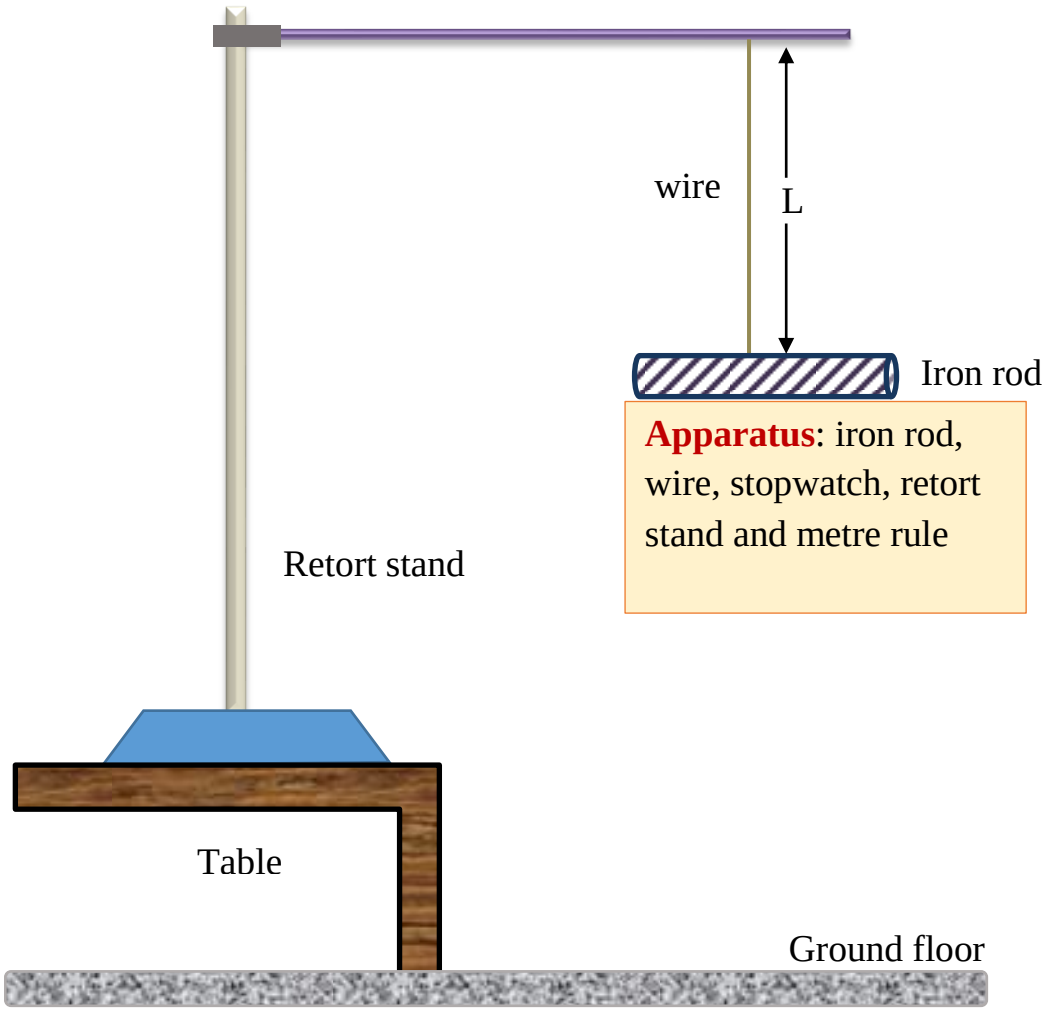


Figure 01

Proceed as follow

(a) Arrange the apparatus as shown in figure 1 above

(b) Tie the rod on the end of the wire, making sure that the rod will hang horizontally.

(c) Suspend the rod on the wire from the retort stand so that the length L=90cm is used. Make the wire straight as possible

(d) Start the rod oscillation in a horizontal plane (this is twisting movement not swinging movement)

(e) Record the time "t" for 20 complete oscillations and hence find the period "T" for this length

(f) Repeat procedure in (c), (d), and (e) above for L=80cm, 70cm, 60cm,50cm and 40cm

Questions

(i) Tabulate your results for L(m) , T(s) and $T^2(s^2)$

(ii) Plot a graph of T^2against L

(iii) Measure and records the radius "a" of the wire provided using micrometer screw gauge and the mass "M" of the material rod and length (L) of the material rod (mass in kg and length in meters)

(iv) You are given that $T = 2\pi\sqrt{\frac{2IL}{\pi\eta a^4}}$ where I-is the moment of inertia of the rod ($I = \frac{ML^2}{12}$) and

$\eta -$ is the coefficient of rigidity of the wire

Determine the value of η from your graph

(v) List two possible source of error

Solution for question 02

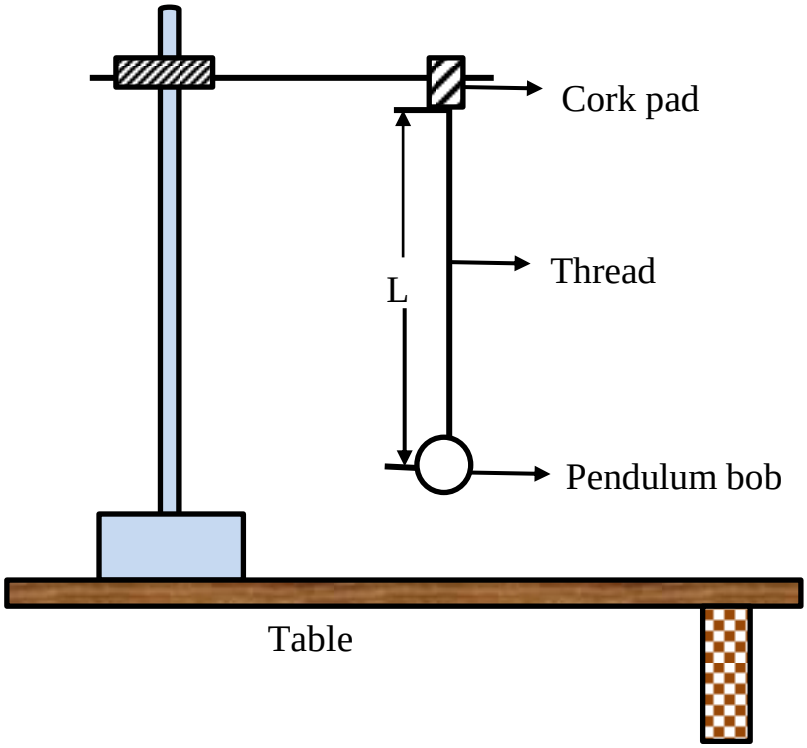
(a) Table of results

L (cm)	t (s)	Period T (s)	$T^2(s^2)$
90	183.60	9.81	84.27
80	151.80	7.59	57.61
70	147.51	7.38	54.46
60	140.40	7.02	49.28
50	132.60	6.63	43.96
40	123.60	6.18	38.19

Question 04

You are required to investigate the variation of length L of a thread with its periodic time. Proceed as follows;

(a) Tie the thread to the given pendulum bob in such a way that the length L= 100cm as shown below



(b) Displace the pendulum bob through a small angle release it so that it swings in to and fro motion with small amplitude. Measure and record the time "t" for 20 complete oscillations, and hence determine the periodic time T.

(c) Repeat the procedures in (b) by reducing the length L by 20cm until you obtain a total of 5 readings

Questions:

(i) Use the dimension nalysis to find the value of "n" from the equation $L=kT^n$, where the unit of K is cm/s^2

(ii) Tabulate the results in (b) and (c) including the column for the value of T^n

(iii) Plot a graph of L against T^n

(iv) Use the equation in (c)(i) and the results obtains in (ii) above to determine the value of K physically.

(v) Compute the value of C given that $C = \frac{g}{k}$

(vi) Acceleration due to gravity "g" is said to be useful in daily life. Identify any two (2) applications of acceleration

(ii)the graph plotted; determine unknown mass M.

Solution Question 04

Way to obtain answer

From

$$L = KT^n$$

by using dimension , the unit of $K = \frac{cm}{s^2}, so\ K = [LT^{-2}]$

By using the principle of homogeneity of dimension , we can obtain the value of n

$$[M^0LT^0] = [M^0LT^{-2}][M^0L^0T^n]$$

$$[T^0] = [T^{-2}][T^n]$$

$$0 = -2 + n$$

$$n = 2$$

then $T^n = T^2$

then from

$$T = 2\pi\sqrt{\frac{L}{g}}$$

For $L = 100cm \cong 1m.\ g = 9.86m/s^2$

$$T = 2\pi\sqrt{\frac{1}{9.86}} = 2.0s$$

Then $t = n \times T = 20 \times 2.0 = 40sec$

For $\mathrm{L} = 80\mathrm{cm} \cong 0.8\mathrm{m}.\,\mathrm{g} = 9.86\mathrm{m}/s^2$

$$T = 2\pi\sqrt{\frac{0.8}{9.86}} = 1.79s$$

Then $t = n \times T = 20 \times 1.79 = 35.8sec$

For $\mathrm{L} = 60\mathrm{cm} \cong 0.6\mathrm{m}.\,\mathrm{g} = 9.86\mathrm{m}/s^2$

$$T = 2\pi\sqrt{\frac{0.6}{9.86}} = 1.55s$$

Then $t = n \times T = 20 \times 1.55 = 31.00sec$

For $\mathrm{L} = 40\mathrm{cm} \cong 0.4\mathrm{m}.\,\mathrm{g} = 9.86\mathrm{m}/s^2$

$$T = 2\pi\sqrt{\frac{0.4}{9.86}} = 1.27s$$

Then $t = n \times T = 20 \times 1.27 = 25.3sec$

For $\mathrm{L} = 20\mathrm{cm} \cong 0.2\mathrm{m}.\,\mathrm{g} = 9.86\mathrm{m}/s^2$

$$T = 2\pi\sqrt{\frac{0.2}{9.86}} = 0.89s$$

Then $t = n \times T = 20 \times 0.89 = 17.90sec$

PRACTICAL REPORT

(c) (i) From

$$\mathrm{L} = \mathrm{KT^n}$$

by using dimension , the unit of $\mathrm{K} = \frac{\mathrm{cm}}{s^2}, so\ \mathrm{K} = [\mathrm{LT^{-2}}]$

By using the principle of homogeneity of dimension , we can obtain the value of n

$$[\mathrm{M^0LT^0}] = [\mathrm{M^0LT^{-2}}][\mathrm{M^0L^0T^n}]$$

$$[\mathrm{T^0}] = [\mathrm{T^{-2}}][\mathrm{T^n}]$$

Slope, K=$\frac{\Delta L(cm)}{\Delta T^n(S^2)}$

Point to from the graph A (3.0, 75) and B (1.8, 45)

K=$\frac{75-45}{3.0-1.8} = \frac{30}{1.2} = 25\text{cm}/s^2$

The Slope, K, of the graph is 25cm/s^2

(v) The value of c was obtained from c = $\frac{g}{k} = \frac{986\text{cm}/s^2/}{25\text{cm}/s^2} =$ 39.44

The value of c is 39.44

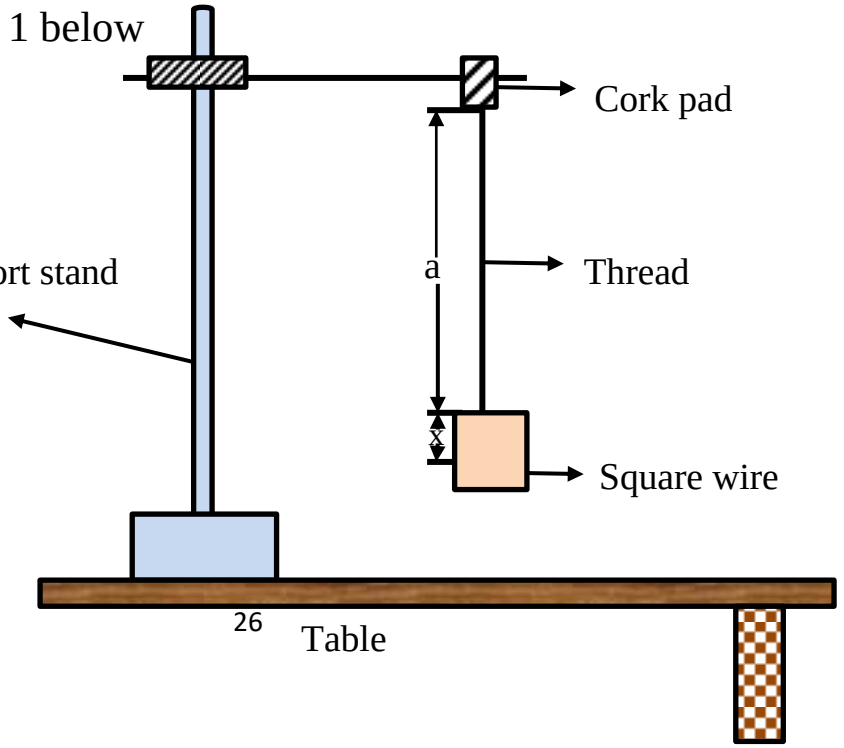
(vi) The two applications of acceleration due to gravity are

- ✓ Due to the presence of gravity we remain on the surface of the earth
- ✓ The rivers continuous to flow from one place to another due to gravity.
- ✓ The prediction about the acceleration and time period of satellites around the earth are accurately measured with the help of gravity

Question 07

You are required to perform the following experiment.

(a) Tie a thread at the centre side of a given square aluminium wire as shown in figure 1 below



(b) Measure a distance a = 20 cm as shown in figure 1 above. Displace the square aluminium wire to a small distance and release it so that it performs to and fro motion. Determine the time t for twenty complete oscillations and hence the periodic time T.

(c) Repeat the procedures in 1 (b) above for values of a = 40 cm, 60 cm, 80 cm and 100 cm.

Questions

(i) Tabulate the values of a, t, T and T^2

(ii) Plot a graph of a (cm) against T^2 (Sec^2)

(iii) Find the slope S of the graph

(iv) Derive an expression governing this experiment

(v) Determine the value of acceleration due to gravity g

(vi) Determine the numerical value of x

(vii) What is the total length L of the aluminium wire?

Solution Question 07

Way to obtain results

From

$$T = 2\pi\sqrt{\frac{a+x}{g}}$$

For $a = 20\text{cm} \cong 0.2\text{m}$. $g = \frac{9.86\text{m}}{s^2}, x = 2.0cm \approx 0.02m$

$$T = 2\pi\sqrt{\frac{0.2+0.02}{9.86}} = 0.94s$$

Then $t = n \times T = 20 \times 0.94 = 18.82sec$

For $a = 40\text{cm} \cong 0.4\text{m}$. $g = 9.86\text{m}/s^2$

$$T = 2\pi\sqrt{\frac{0.4+0.02}{9.86}} = 1.30s$$

Then $t = n \times T = 20 \times 1.30 = 26.00sec$

For a $= 60\text{cm} \cong 0.6\text{m}.\ \text{g} = 9.86\text{m}/s^2$

$$T = 2\pi\sqrt{\frac{0.6 + 0.02}{9.86}} = 1.58s$$

Then $t = n \times T = 20 \times 1.58 = 31.60sec$

For a $= 80\text{cm} \cong 0.8\text{m}.\ \text{g} = 9.86\text{m}/s^2$

$$T = 2\pi\sqrt{\frac{0.8 + 0.02}{9.86}} = 1.82s$$

Then $t = n \times T = 20 \times 1.82 = 36.40sec$

For a $= 100\text{cm} \cong 1\text{m}.\ \text{g} = 9.86\text{m}/s^2$

$$T = 2\pi\sqrt{\frac{1 + 0.02}{9.86}} = 2.03s$$

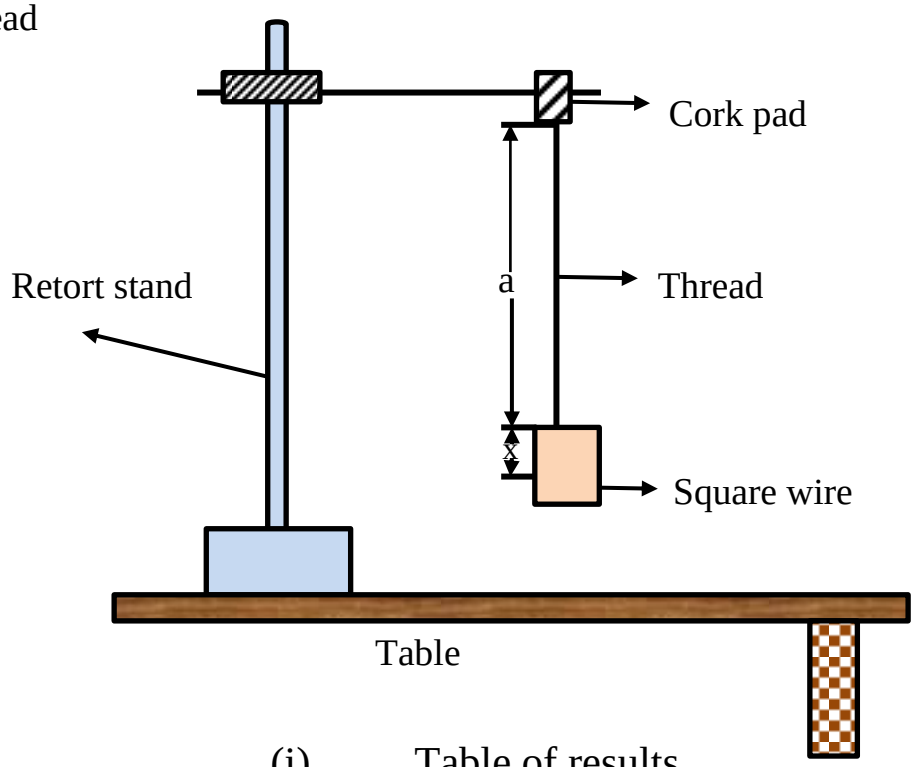
Then $t = n \times T = 20 \times 2.03 = 40.60sec$

PRACTICAL REPORT

The aim of this experiment is to determine the acceleration due to gravity g and the length of square wire given L

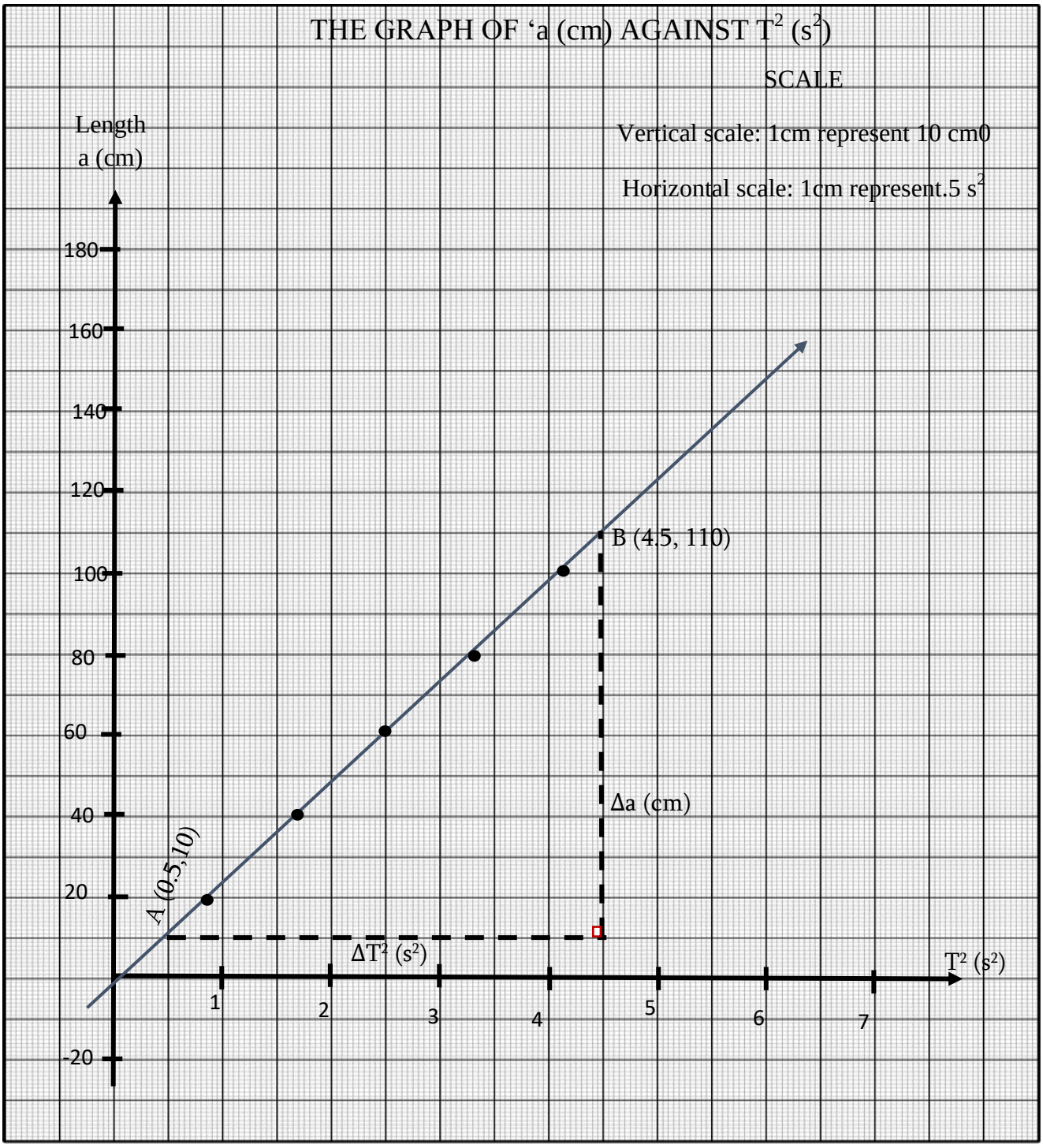
Apparatus and materials given

- Square Wire (4× 4)cm
- Cork pad
- retort stand
- Stop watch
- Metre rule
- Thread



(i) Table of results

Length a(cm)	Time ,t(cm)	Period, T(s)	$T^2(s^2)$
100	40.6	2.03	4.12
80	36.40	1.82	3.31
60	31.60	1.58	2.50
40	26.00	1.3	1.69
20	18.82	0.94	0.88



(iii) Slope from the graph

$$\text{Slope m} = \frac{\Delta a(cm)}{\Delta T^2(s^2)}$$

Point to from the graph A (0.5, 10) and B (4.5, 110)

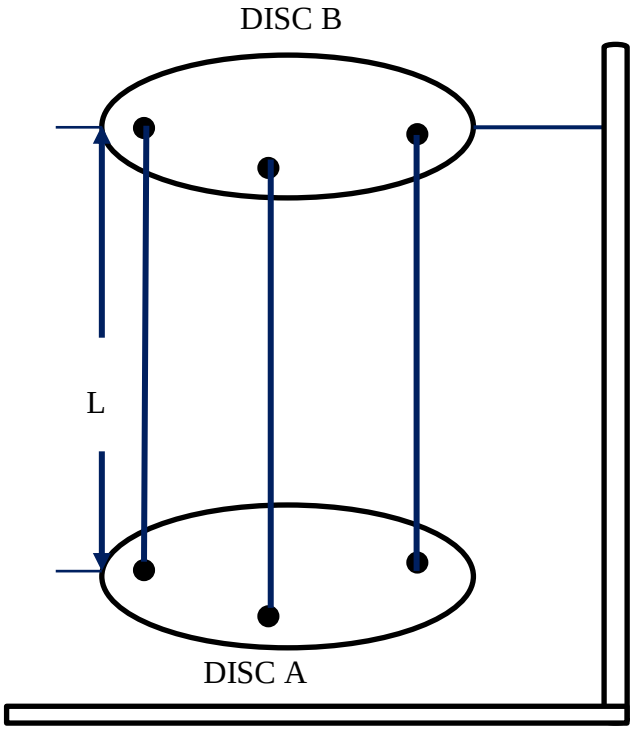
Question 10

The aim of this experiment is to investigate how the period of torsional oscillations of the suspended disc depends on the mass m which it carries. You are provided with two cardboard discs. Each disc has three (3) small holes placed at regular Intervals near the edge. One of the discs labelled A has pieces of strings threaded through the holes as disc B.

(a) (i). Clamp disc B horizontally using two small blocks of wood. Suspend disc A vertically below disc B by using strings through the holes as shown in figure 1 below.

(ii) Place 50g mass at the center of disc A.

(iii) Adjust the length of the three (3) strings until L=100cm



(b) (i) Gently rotate disc A through a small angular displacement and release it so that the disc performs torsional oscillations in a horizontal plane as shown in figure 2 above.

(ii) Mark and record the time taken for 10 oscillations, then find the period T

(c) Repeat (b)(i) and (ii). For different values of m stacking the slotted masses on top of each other until you have six sets of reading of T and m. include the values of Log T and Log **m** in your table of results

(d) . T and m are related approximately by a simple power law of the form T=K

(i) Plot the graph of Log T against Log m and draw the best line through the points

(ii) Determine the gradient and the intercept at Log T axis

(iii) Use your answers of (d)(ii) above to calculate the numerical values of n and K.

(e) (i). Replace the masses with unknown mass M which has been provided.

(iii) Then let the disc performs torsional oscillations and find time for 10 oscillations as before; then find period T and Log T

(iv) Using the graph plotted; determine unknown mass M.

Solution Question 10

(c) Table of results

M(g)	t(sec)	T (sec)	Log T	Log m
50	10.0	1.00	0.000	1.7
100	8.1	0.82	-0.092	2.0
150	7.0	0.70	-0.155	2.2
200	6.6	0.66	-0.181	2.3
250	6.0	0.60	-0.222	2.4
300	5.8	0.58	-0.237	2.5

(d)

From

$T = KM^n$ apply log both side

$$\log T = n\log M + \log k$$

Thus

$$\begin{array}{cccc} \log T = & n\log M & + \log k \\ \uparrow & \uparrow & \uparrow & \uparrow \\ y = & m & x & + c \end{array}$$

(c) The graph of Log T against Log m

Slope S=$\frac{\Delta Log\ T(Sec)}{\Delta \log M(g)}$

Point to from the graph A (0.6, 0.4) and B (1.2, 0.2)

S=$\frac{0.4-0.2}{0.6-1.2}\frac{(Sec)}{(g)} = -0.33sec/g$

Slope (k) =$-0.33sec/g$

(vii) The value of $C = 0.6$

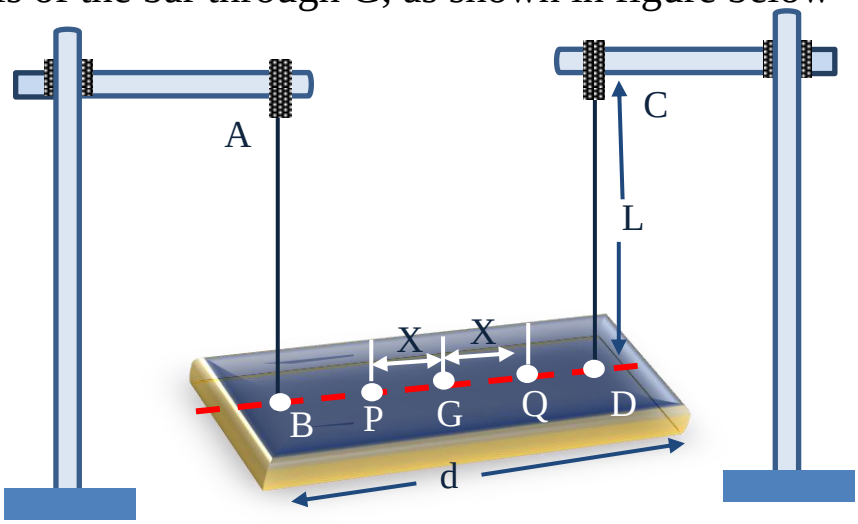
$\log K = 0.6, K = log^{-1}(0.6) = 3.98$

Also the x- intercepts $\log m = 1.7, m = log^{-1}(1.7) = 50.1g$

Question 11

The aim of the experiment was to determine the moment of inertia, I of a wooden bar acting as a bifilar pendulum, proceed as follows

(i) Locate the centre of gravity G of the wooden bar by balancing it on a knife edge provided. Draw the horizontal axis of the bar through G, as shown in figure below



(ii) Using a piece of cork and pieces of thread provided, suspend the wooden bar as shown, such that L=d=AB=CD=100cm make sure that the thread are vertical and parallel

(iii) Make adjustment such that the wooden bar is perfectly horizontal and the length d is symmetrical about G such that GB=GD

(iv) Measure the distance x=5cm from each side of G and let the arbitrary distance positions be P and Q

(v) Place 100g at P and another 100g at Q and then firmly on the wooden bar using the lighter rubber bands provided , set the wooden bar oscillatinf about a vertical axis through G. record the time t for 10 completely oscillation and calculate their corresponding periodic time T

(vi) Move the mass 100g along the horizontal axis about the centre of mass of the wooden bar by increasing the distance x in interval of 5cm from each side of G. at each position of masses , measure time t for 10 complete oscillation and its corresponding periodic time T, hence tabulate your results

(vii) Plot the graph of T^2 against X^2

(viii) Given that $T^2 = \frac{16\pi^2 IL}{(M+m)gd^2} + \frac{16\pi^2 mLx^2}{(M+m)gd^2}$ where L and d are expressed in SI unit, g=9.81m/s^2, m=0.2kg. Use your graph to determine M and I. what does M represent

(ix) Mention any precaution that you think it will be taken so as to perform well an experiment

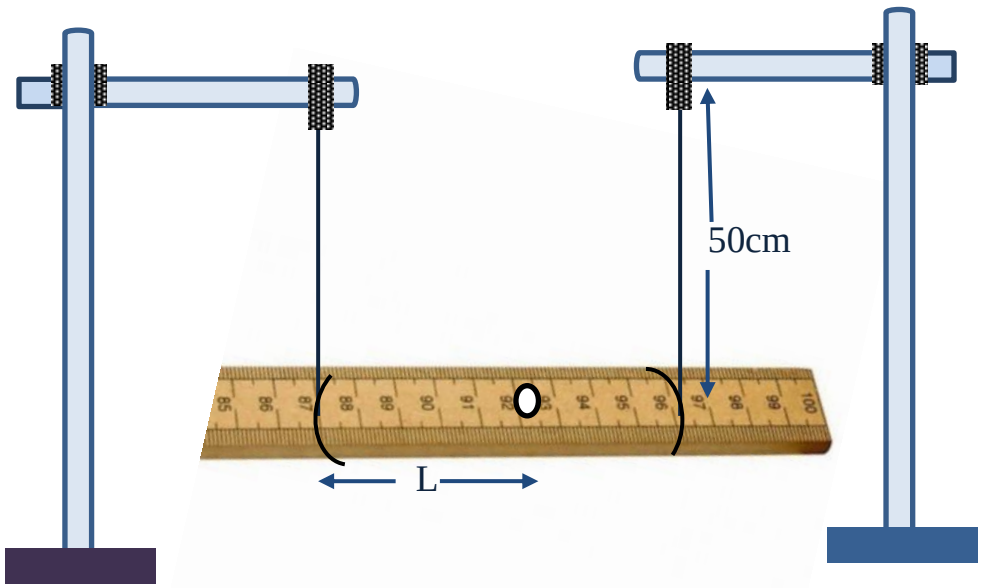
Solution for question 11

Way to obtain data

From

$I = M(K^2 + L^2)$, where $M - mass\ of\ bar$,K-radius of gyration and I-moment of inertia

$$K = \sqrt{\frac{GB \times GQ + GD \times GP}{2}} = \sqrt{\frac{45 \times 5 + 5 \times 45}{2}} = 15cm$$



(b) Set the pendulum (the rule) swinging horizontally by displacing the ends of the rule in the opposite direction through a small angle.

(c) Determine the time, t needed for 10 such oscillations of the pendulum.

(d) Keeping the lengths of the threads fixed and the distance between the clamps unchanged; reduce the separation, L between the loops making sure that the loops are equidistant from the mid-point of the rule.

(e) Repeat the procedure above to obtain more five reading by reducing the value of L and determine the time, t for 10 complete oscillations.

Question

(i) Tabulate the results including log T and log L

(ii) Plot the graph of log T against log L

(iii) From the graph determine its slope

(iv) From the given relationship

$\text{Log}_{10}\text{T} = -\text{nLog}_{10}\text{ L} + \text{Log}_{10}\text{k}$ Determine the value of K and deduce the relationship between T and L

Solution for question 12

Way to obtain data

From$T = 2\pi\sqrt{\frac{4Ih}{MgL^2}}$, but $I = \frac{Mh^2}{12}$

Then$T = 2\pi\sqrt{\frac{4\left(\frac{Mh^2}{12}\right)h}{MgL^2}} = 2\pi\sqrt{\frac{h^3}{3gL^2}}$,

$T = 2\pi\sqrt{\frac{h^3}{3gL^2}}$, Thus $h = 50cm \approx 0.5cm, g = \frac{9.81m}{s^2}, n = 10\ oscillation$

$$for\ L = 40cm\ , T = ?$$

$$T = 2\pi\sqrt{\frac{(0.5)^3}{3 \times 9.81 \times (0.4)^2}} = 1.024$$

$$t = nT = 10 \times 1.024 = 10.24sec$$

For $L = 35cm = 0.35m, T = ?$

$$T = 2\pi\sqrt{\frac{(0.5)^3}{3 \times 9.81 \times (0.35)^2}} = 1.169$$

$$t = nT = 10 \times 1.169 = 11.69sec$$

For $L = 30cm = 0.3m, T = ?$

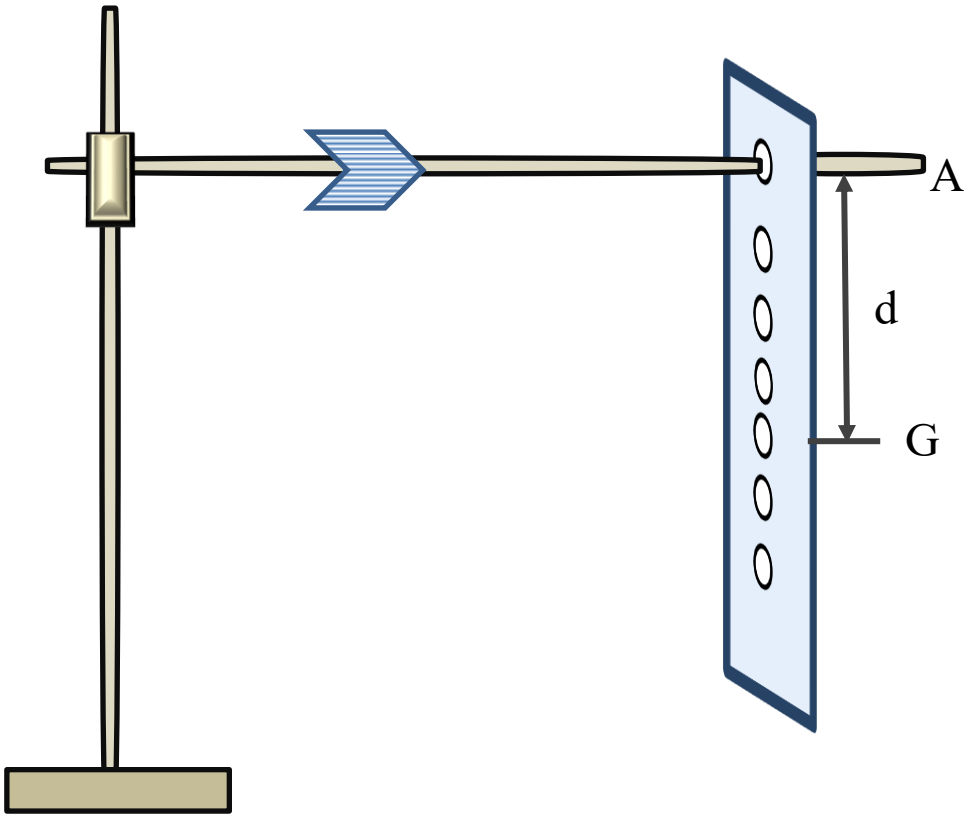
$$T = 2\pi\sqrt{\frac{(0.5)^3}{3 \times 9.81 \times (0.3)^2}} = 1.365$$

$$t = nT = 10 \times 1.365 = 13.65sec$$

For $L = 25cm = 0.25m, T = ?$

Question 13

The aim of this experiment is to determine the gravitational intensity, g and the radius of gyration, k of the given wooded bar of length 1metre . procceed as follows



(a) (i) Set up the apparatus as shown in Fig.Above. The length AG is the distance, d measured from the center of gravity G of the block. Suspend the block of wood from a hole made at one end.

(ii) With a stop watch, take the time "t" for 10 small complete oscillations of the block, and hence determine the periodic time, T.

(iii) Repeat the above procedures with 6 other values of d, and in each case, record the corresponding time, t and hence the periodic time T. Make a table that includes the following headings:- d, t, T, T^2d, and d^2,

(b) Given that the periodic time, T is given b $T = 2\pi\sqrt{\frac{K^2+d^2}{gd}}$ Where k is the radius of gyration of the block of wood about the center of gravity, then:-

(c) Plot a graph of T^2d against d^2.

(d) Use your graph and the equation above to determine:

(i) The gravitational intensity, g

(ii) The radius of gyration, k

Solution for question 13

Way to obtain data

From

$$I = I_g + md^2, \text{but } I_g = mk^2$$

$$I = mk^2 + md^2$$

Thus

$$T = 2\pi\sqrt{\frac{I}{mgd}}, T = 2\pi\sqrt{\frac{m(k^2+d^2)}{mgd}}$$

$$T = 2\pi\sqrt{\frac{(k^2+d^2)}{gd}} \text{Then } k^2 = \frac{l^2}{12}$$

$$T = 2\pi\sqrt{\frac{\left(\frac{l^2}{12}+d^2\right)}{gd}}$$ Where l=100cm-length of wooden bar,

Thus

For d=40cm=0.4m

$$\mathrm{T} = 2\pi\sqrt{\frac{\left(\frac{(1)^2}{12} + (0.4)^2\right)}{9.81 \times 0.4}} = 1.565$$

$$t = nT = 10 \times 1.56 = 15.65sec$$

For d=35cm=0.35m

$$\mathrm{T} = 2\pi\sqrt{\frac{\left(\frac{(1)^2}{12} + (0.35)^2\right)}{9.81 \times 0.35}} = 1.538$$

$$t = nT = 10 \times 1.538 = 15.38sec$$

For d=30cm=0.3m

$$\mathrm{T} = 2\pi\sqrt{\frac{\left(\frac{(1)^2}{12} + (0.3)^2\right)}{9.81 \times 0.3}} = 1.525$$

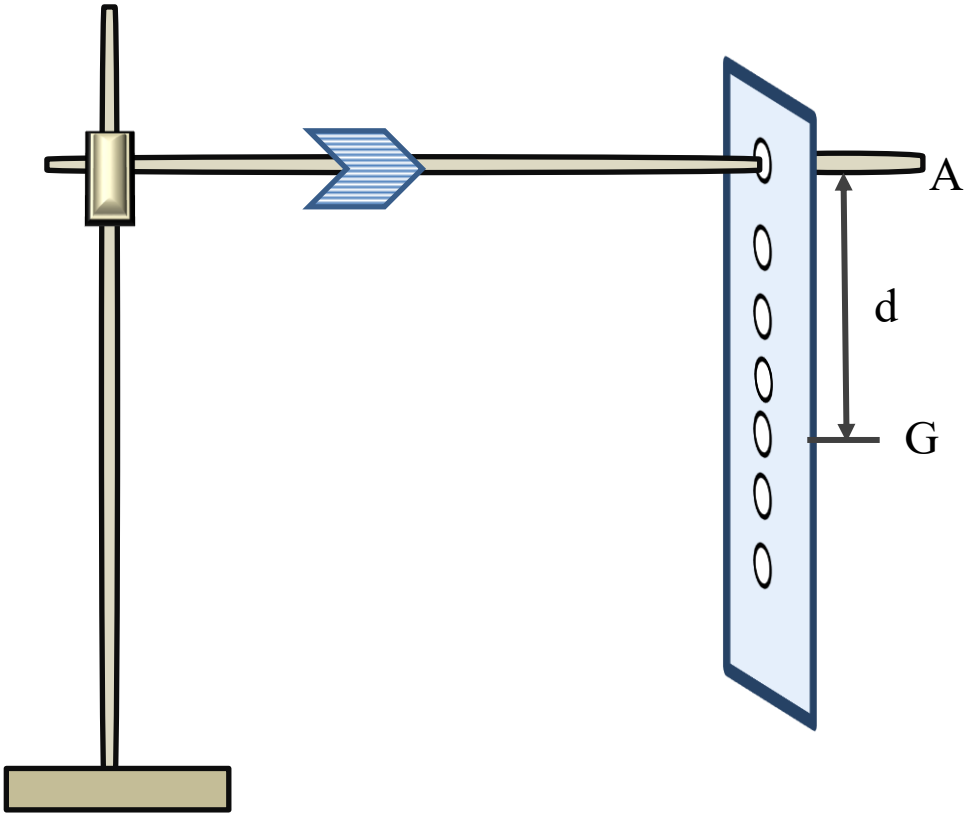
$$t = nT = 10 \times 1.525 = 15.25sec$$

For d=25cm=0.25m

$$\mathrm{T} = 2\pi\sqrt{\frac{\left(\frac{(1)^2}{12} + (0.25)^2\right)}{9.81 \times 0.25}} = 1.532$$

$$t = nT = 10 \times 1.532 = 15.32sec$$

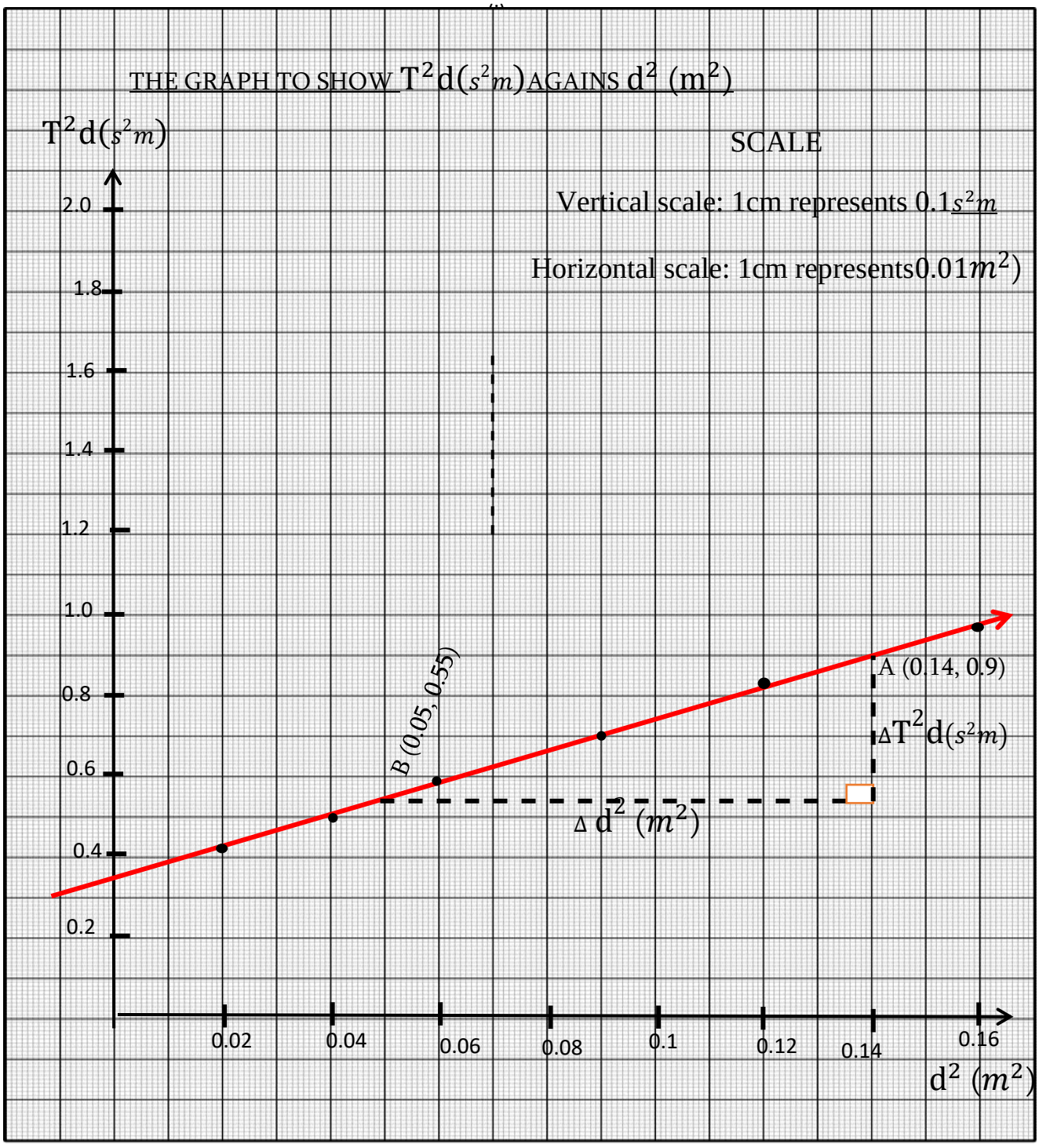
For d=20cm=0.2m



(b) Table of results

d(cm)	Time t(sec)	Period T(sec)	$T^2(s^2)$	$d^2(m^2)$	$T^2d(s^2m)$
40	15.65	1.565	2.45	0.16	0.98
35	15.38	1.538	2.37	**0.12**	**0.83**
30	15.25	1.525	2.33	0.09	0.70
25	15.32	1.532	2.35	0.06	0.59
20	15.75	1.575	2.48	0.04	0.50
15	16.85	1.685	2.84	0.02	0.43

(c) the a graph of T^2d against d^2



(i) the slope S=$\frac{\Delta T^2 d(s^2m)}{\Delta\, d^2\ (m^2)}$

Point to from the graph A (0.14, 0.9) and B (0.05, 0.55)

$$S=\frac{0.9-0.55}{(1.14-0.05)}=3.89s^2/m$$

The Slope, S, of the graph is $3.89s^2/m$

(ii) From

$$T=2\pi\sqrt{\frac{K^2+d^2}{gd}}$$

$$T^2=4\pi^2\left(\frac{K^2+d^2}{gd}\right), T^2d=\frac{4\pi^2}{g}(K^2+d^2)$$

$$T^2d=\frac{4\pi^2}{g}K^2+\frac{4\pi^2}{g}d^2$$

$$T^2d=\frac{4\pi^2}{g}d^2+\frac{4\pi^2}{g}K^2$$

$$\begin{array}{ccccccc} T^2d & = & \frac{4\pi^2}{g}d^2 & + & \frac{4\pi^2}{g}K^2 \\ \uparrow & & \uparrow & & \uparrow \\ y & = & M & x & + & C \end{array}$$

$$slope\ (S)=\frac{4\pi^2}{g}, but\ =3.89s^2/m$$

$$g=\frac{4\pi^2}{S}=\frac{4\pi^2}{3.89s^2/m}=10.15m/s^2$$

The value of acceleration due to gravity is $10.15m/s^2$

(ii) $also\ n\ y-intercept\ is\ 0.35s^2m$

$$c=\frac{4\pi^2}{g}K^2.K=\sqrt{\frac{cg}{4\pi^2}}$$

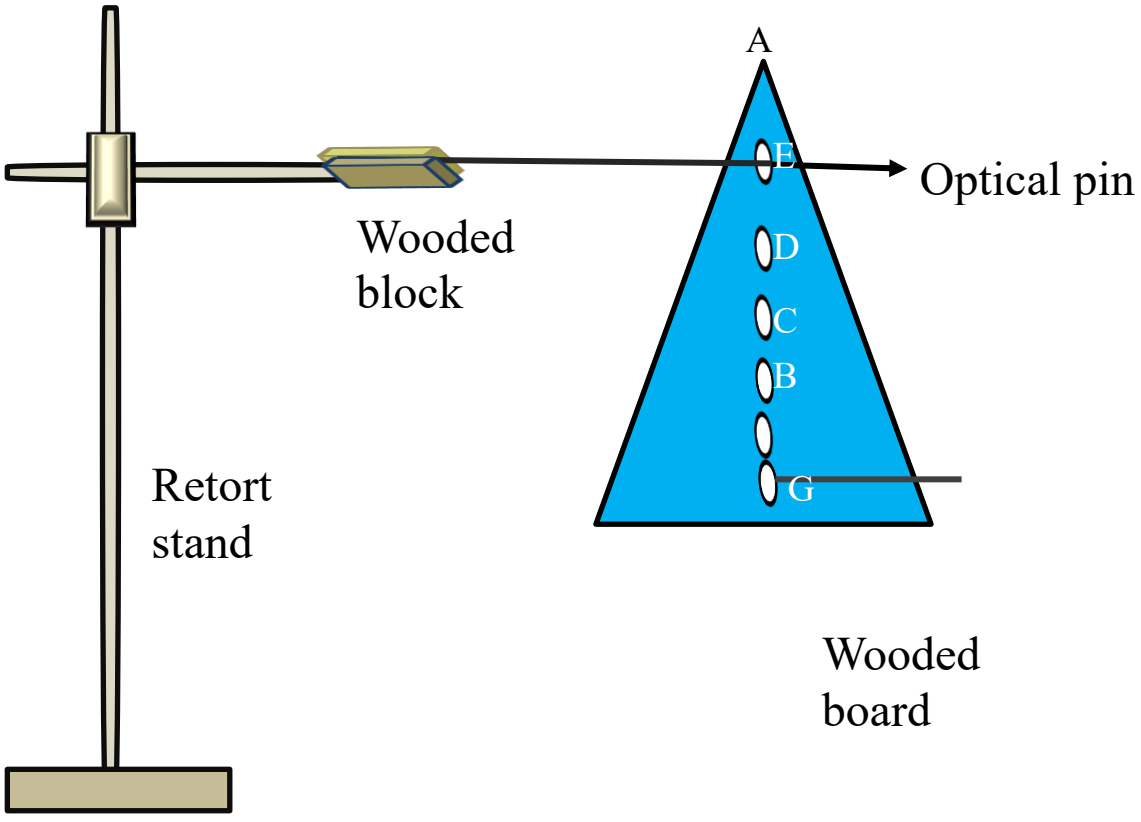
Question 16

The aim of this experiment is to determine the acceleration due to gravity, g and radius of gyration, k of the triangular sheet of card-board provided.

Proceed as follows:

(a) Using the weighted string (or plumbline) provided, locate the center of gravity G of the triangular sheet of card-board. Briefly, with the aid of a sketch diagram, explain how you obtain G.

(b) Draw a line joining G and the farthest angle (Apex) A of the card-board. Measure a distance 2 cm from G, along the line GA. Make a hole at this point. Make five other holes along GA at distances 2cm from each other



(c) Set up the apparatus as shown in Figure above. The pin should be clamped tightly between the two pieces of corks. Suspend the triangular card-board from a hole nearest the center of Gravity G. Record h, which is the distance of the point of suspension from G.With the stop watch provided, obtain the time, t for 10 small complete oscillations of the card-board and hence determine the periodic time, T. Repeat the abov e procedure with five other values of h to obtain corresponding values of t and T.

(d) Plot a graph of h^2 against T^2h

(e) Given that $T^2h = \frac{4\pi^2}{g}(K^2 + h^2)$Determine, with the aid of your graph,

(i) The acceleration, g, due to gravity,

(ii) The radius of gyration, k.

Solution for question 16

Way to obtain data

From

$$I_P = I_g + I_s, \text{but } I_g = I_s = I = \frac{ml^2}{12}$$

$$I_P = 2I = \frac{2ml^2}{12} = \frac{ml^2}{6}$$

$$I_P = Mk^2, \frac{ml^2}{6} = Mk^2$$

$$k^2 = \frac{l^2}{6}$$

Thus

$$T = 2\pi\sqrt{\frac{m(k^2 + h^2)}{mgh}}$$

$$T = 2\pi\sqrt{\frac{(k^2+h^2)}{gh}} \text{Then } k^2 = \frac{l^2}{6}$$

$T = 2\pi\sqrt{\frac{\left(\frac{l^2}{6}+h^2\right)}{gh}}$ Where l- is the length from the vertex to one side, thus l=25cm,

Then

For h=2cm=0.02m

$$T = 2\pi\sqrt{\frac{\left(\frac{(0.25)^2}{6} + (0.02)^2\right)}{9.81 \times 0.02}} = 1.475$$

$$t = nT = 10 \times 1.475 = 14.75sec$$

For h=4cm=0.04m

$$T = 2\pi\sqrt{\frac{\left(\frac{(0.25)^2}{6} + (0.04)^2\right)}{9.81 \times 0.04}} = 1.100$$

$$t = nT = 10 \times 1.100 = 11.00sec$$

For h=6cm=0.06m

$$T = 2\pi\sqrt{\frac{\left(\frac{(0.25)^2}{6} + (0.06)^2\right)}{9.81 \times 0.06}} = 0.969$$

$$t = nT = 10 \times 0.969 = 9.69sec$$

For h=6cm=0.08m

$$\mathrm{T} = 2\pi\sqrt{\frac{\left(\frac{(0.25)^2}{6} + (0.08)^2\right)}{9.81 \times 0.08}} = 0.919$$

$$t = nT = 10 \times 0.919 = 9.19sec$$

For h=10cm=0.1m

$$\mathrm{T} = 2\pi\sqrt{\frac{\left(\frac{(0.25)^2}{6} + (0.1)^2\right)}{9.81 \times 0.1}} = 0.906$$

$$t = nT = 10 \times 0.906 = 9.06sec$$

For h=12cm=0.12m

$$\mathrm{T} = 2\pi\sqrt{\frac{\left(\frac{(0.25)^2}{6} + (0.12)^2\right)}{9.81 \times 0.12}} = 0.912$$

$$t = nT = 10 \times 0.912 = 9.12sec$$

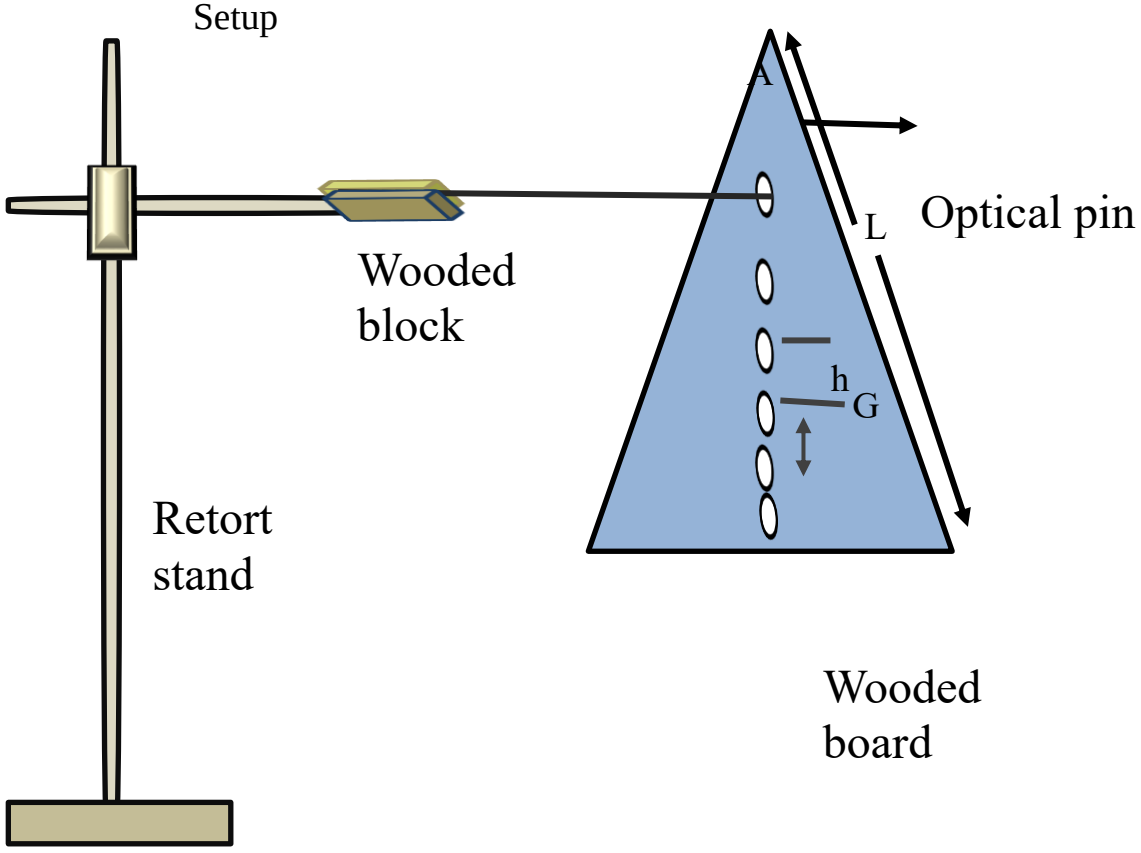
PRACTICAL REPORT

The aim of this experiment is to determine the acceleration due to gravity, g and radius of gyration, k of the triangular sheet of card-board provided.

Apparatus and materials given

- triangular sheet of card-board Optical pin
- retort stand
- Stop watch
- Metre rule

Setup



The table below

Distance ,h (cm)	Time for 10 oscillation t(s)	Period T(s)	$T^2(s^2)$	$T^2h(s^2m)$	$h^2(m^2)(\times 10^{-3})$
2	14.75	1.475	2.18	0.044	0.4
4	11.00	1.100	1.21	0.048	1.6
6	9.69	0.969	0.94	0.056	3.6
8	9.19	0.919	0.85	0.068	6.4
10	9.06	0.906	0.82	0.082	10.0
12	9.12	0.912	0.83	0.10	14.4

$$c = \frac{4\pi^2}{g} K^2 . K = \sqrt{\frac{cp}{4\pi^2}}$$

$$K = \sqrt{\frac{0.82 s^2 m \times 9.87 m/s^2}{4\pi^2}} = 0.45m$$

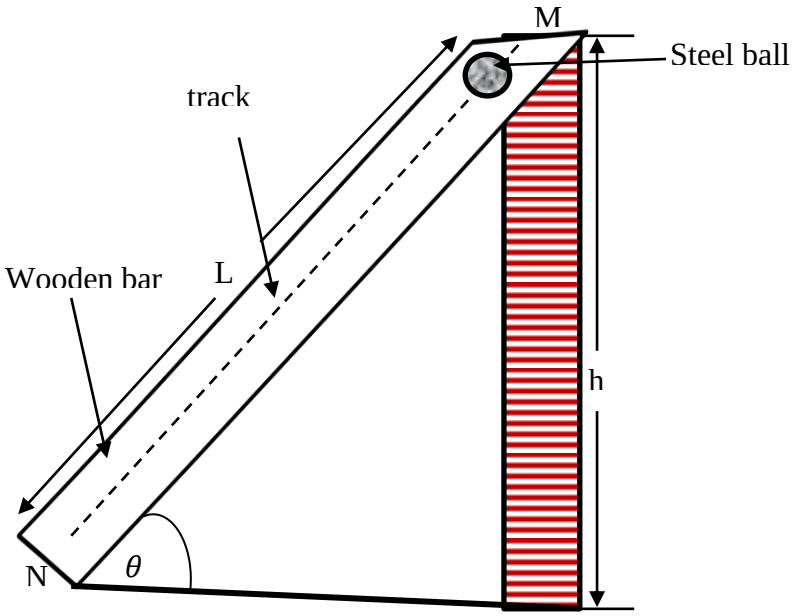
The radius of gyration, k is $0.45m$

Question 18

The aim of this experiment is to determine the radius of gyration of a solid steel spherical ball about an axis through its centre.

Proceed as follows

(a) Place ten 10 wooden block of dimension 5cm× 3cm × 0.8cm one of the top of the other so that the total height h is 8cm, place wooden bar of length 120cm so that it makes an inclination as shown in the figure below. The wooden bar should have a track made at its centre to enable a ball to roll with L=110cm. start the ball from the rest at M measure the time t taken to reach the bottom at N. Repeat this ten times



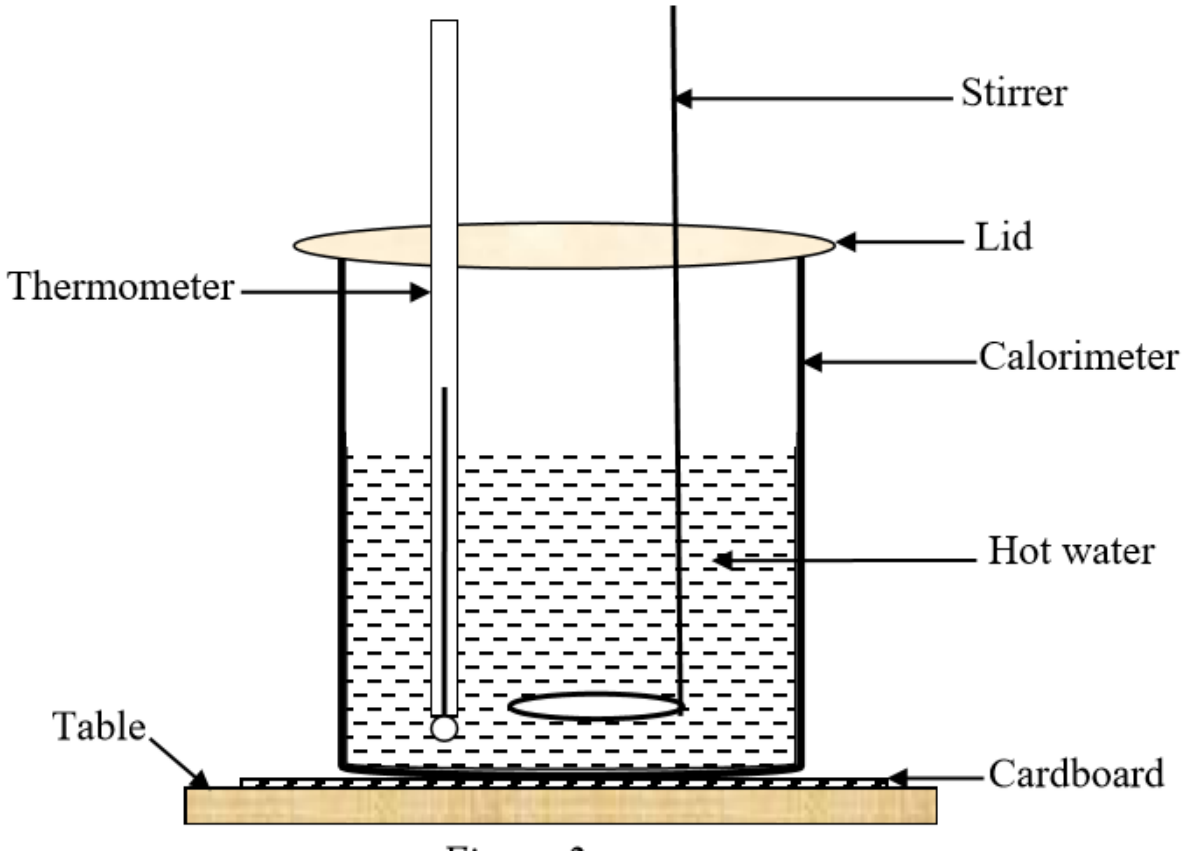
Question 20

In this experiment you are required to investigate the relationship between the rate of loss of heat from a 250ml beaker and the excess temperature over the surrounding under forced convections.

Proceed as follows:

(i) Read and record the room temperature just before you begin this experiment θ_i.

(ii) Place the 250 ml beaker on a wooden base, pour 200ml of water which have been heated to about 85℃ and observe the temperature change for every two minutes intervals, starting with 80℃ at t = 0, stir gently by using stirrer and take the readings for a duration of 14 minutes



(iii) Read and record the final room temperature θ_f and calculate the average room temperature θ_{av}

(iv) Tabulate your results

(v) Plot the graph of $\log(\theta - \theta_{av}) = -kt + C$.

(vi) Use your graph and the equation $\log(\theta - \theta_{av}) = -kt + C$. Find the value of k and C

(vii) State the physical meaning of k and

Solution Question 20

Way to obtain data

Record the temperature of surrounding $(\theta_0) = 25℃$

Record the initial temperature from the two bodies $(\theta_t) = 85℃$

Record the temperature of a blackened calorimeter after 1 minutes $\theta = 80℃$

From

$$\theta = \theta_0 + (\theta_t - \theta_0)e^{-kt}$$

for t-1minutes

$$80℃ = 25 + (85 - 25)e^{-k(1)}$$

$$80 - 25 = (85 - 25)e^{-k(1)}$$

$$55 = 60e^{-k(1)}$$

$$\frac{57}{62} = e^{-k}, \ldots\ldots(i)$$

$$apply \ln both\ side$$

$$ln\left(\frac{57}{62}\right) = -k\ln e$$

$$k = 0.084$$

Question 21

The aim of this experiment is to determine the specific heat capacity of the Liquid L provided by the method of cooling.

Proceed as follows:-

You are provided with a calorimeter whose specific heat capacity is known, Liquid L, stopwatch, water and thermometer (of range 0-100℃)

(a) Pour about 120 cm^3 of the oil in a beaker and warm it until it reaches a temperature of about 60℃.

(b) Weigh the calorimeter and place it on insulting supports as shown in Figure below

(c) Measure 100 cm^3 of the warm oil and pour it into the calorimeter.

(d) Record the temperature fall at intervals of 30 seconds until a

temperature of about 45 ℃ is reached.

(e) Reweigh the calorimeter with oil.

(f) Repeat the experiment using water in place of oil.

Questions

(i) Tabulate your results.

(ii) Plot on the same scale, and axes of your graph paper, a graph of temperature, θ℃ against time, t for both water and oil.

(iii) Find the time, in seconds, for the water and the oil to cool by two degrees from the graph. Record these at t_1 and t_2 for water and oil respectively.

(iv) Using the formula

$(mc + m_1c_1)(\theta_2 - \theta_1) = (m_2c_w + m_1c_1)(\theta_2 - \theta_1)$

Where:

m_L = Mass of liquid L

m_c = Mass of calorimeter

m_w = Mass of water

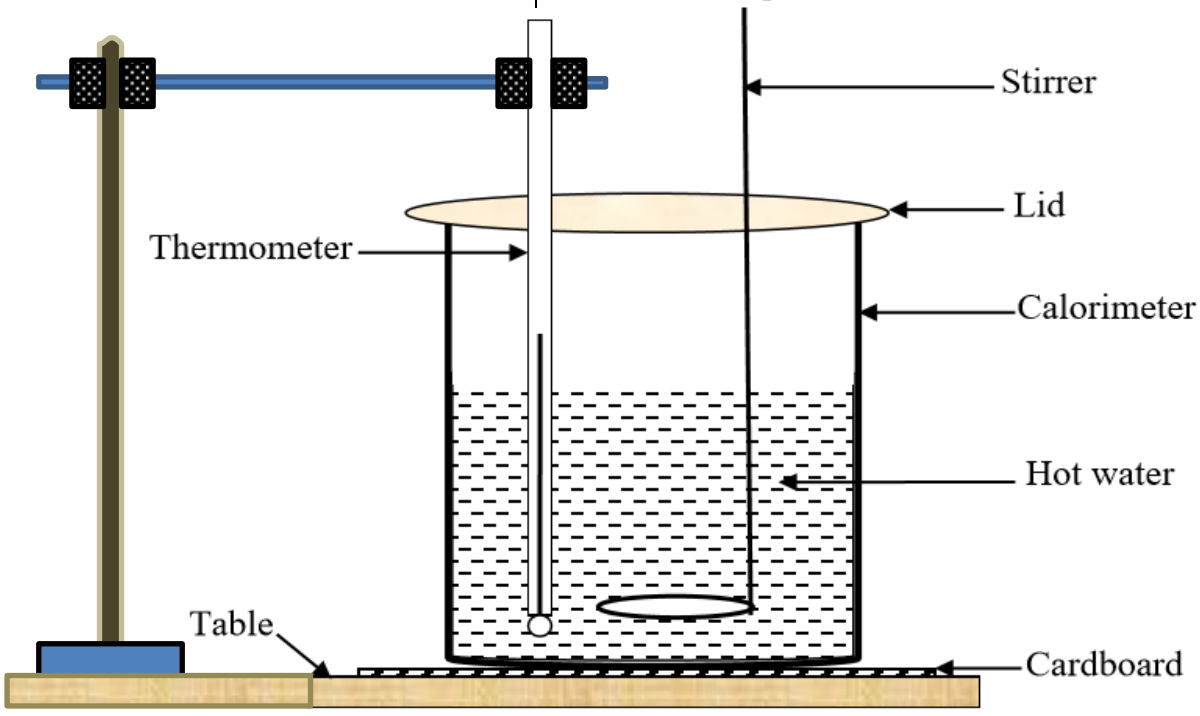
c_L = Specific heat capacity of liquid L

c_w =Specific heat capacity of water = $4200\ Jkg^{-1}K^{-1}$

c_C =Specific heat capacity of calorimeter = $380\ Jkg^{-1}K^{-1}$

Calculate c, the specific heat capacity of the oil

(v) State any sources of errors and precautions taken.



Solution Question 21

PRACTICAL REPORT

AIM: the aim of experiment was to determine the specific heat capacity of liquid L

Apparatus and instrument used

- ✓ Calorimeter with lid and stirrer
- ✓ Thermometer
- ✓ Stop watch
- ✓ Heater
- ✓ Water
- ✓ Liquid L
- ✓ Beam balance
- ✓ Retort stand

Setups

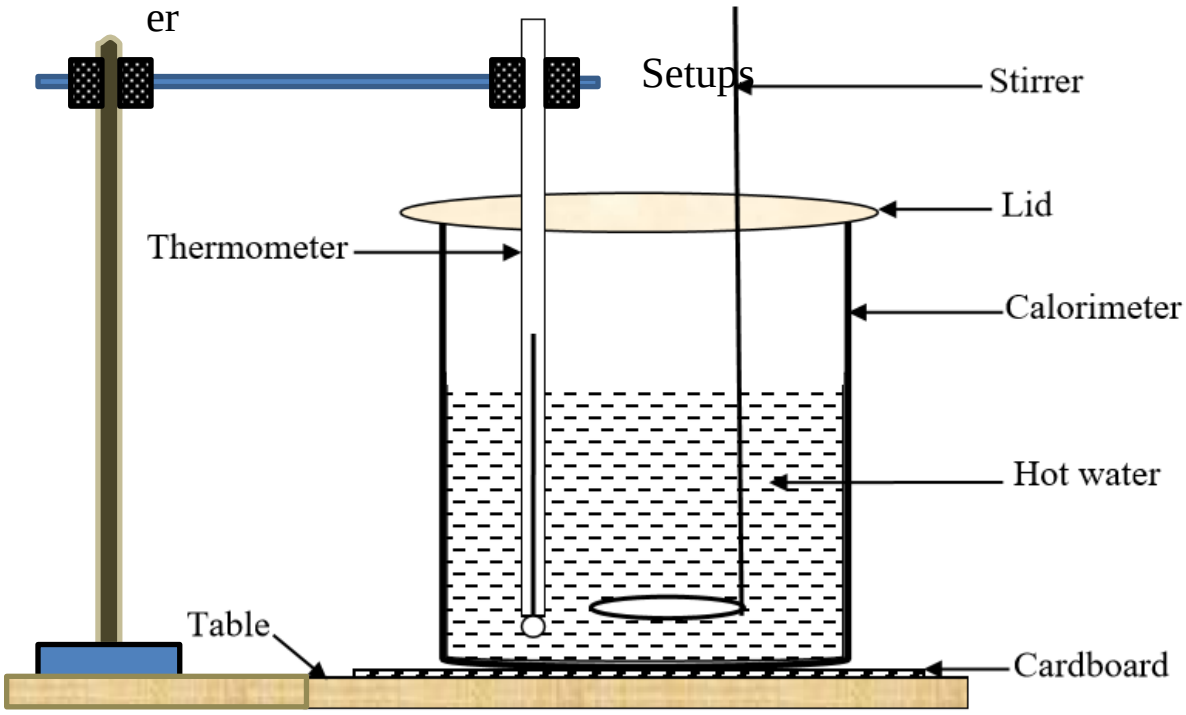


Table of results for water

Time (min)	0	2	4	6	8	10	12	14	16	18	20
Temperature(℃)	50.0	47.0	45.8	44.8	43.8	42.8	42.0	41.5	39.5	38.9	38.4

22	24	26	28
37.8	37.3	36.5	36,0

Table of results for Liquid L

From the graph ,by using water cooling curve , the gradient For water is determined by $\frac{dQ}{dt}$

At $t_1 = 3.0\,\min(6.9, 43.0)$ and $(1.5, 47.5)$

$$\frac{dQ}{dt_1} = \frac{43.0 - 47.5}{6.9 - 1.5} = -0.83$$

At $t_2 = 9.0\,\min(10.0, 42.7)$ and $(7.0, 44.2)$

$$\frac{dQ}{dt_2} = \frac{42.7 - 44.2}{10.0 - 7.0} = -0.5$$

At $t_3 = 18.0\,\min(22.7, 37.0)$ and $(15.0,39.7)$

$$\frac{dQ}{dt_3} = \frac{39.7 - 37.0}{15.0 - 22.7} = -0.35$$

Average change in temperature

$$\text{average } \left(\frac{dQ_w}{dt}\right) = \frac{\frac{dQ}{dt_2} + \frac{dQ}{dt_1} + \frac{dQ}{dt_3}}{3} = \frac{-0.83 - 0.5 - 0.35}{3} = -0.56℃/min$$

the gradient For Liquid L Curve

At $t_1 = 3.0\,\min(1.2, 47.5)$ and $(3.9, 44.5)$

$$\frac{dQ}{dt_1} = \frac{44.5 - 47.5}{3.9 - 1.2} = -1.04$$

At $t_2 = 9.0\,\min(10.7, 39.0)$ and $(8.0, 41.0)$

$$\frac{dQ}{dt_2} = \frac{41.0 - 39.0}{8.0 - 10{,}7} = -0.74$$

At $t_3 = 15.0\,\min(13.4, 37.5)$ and $(17.7,35.5)$

$$\frac{dQ}{dt_3} = \frac{35.5 - 37.5}{17.7 - 13.5} = -0.48$$

Average change in temperature

$$\text{average } \left(\frac{dQ_L}{dt}\right) = \frac{\frac{dQ}{dt_2} + \frac{dQ}{dt_1} + \frac{dQ}{dt_3}}{3} = \frac{-1.04 - 0.74 - 0.48}{3} = -0.75℃/min$$

By using beam balance ,the following data were obtained experimentally

Mass of calorimeter $(M_c) = 141.2g$

Mass of calorimeter +water $(M_c + M_w) = 237.2g$

Mass of calorimeter +Liquid L $(M_c + M_L) = 225.9g$

Mass o Mass of water $(M_w) = (M_c + M_w) - M_c = 237.2g - 141.2g = 96g$

Mass o Mass of liquid L $(M_L) = (M_c + M_L) - M_c = 225.9g - 141.2g = 84.7g$

From

$$(m_L c_L + m_c c_c)\left(\frac{dQ_L}{dt}\right) = (m_w c_w + m_c c_c)\left(\frac{dQ_w}{dt}\right)$$

$$C_L = \left\{\frac{(m_w c_w + m_c c_c)\left(\frac{dQ_w}{dt}\right) - m_c c_c \left(\frac{dQ_L}{dt}\right)}{m\left(\frac{dQ_L}{dt}\right)}\right\}$$

$$C_L = \left\{\frac{(0.096 \times 4200\ Jkg^{-1}K^{-1} + 0.1412 \times 390)(-0.56℃/min) - (0.1412 \times 390 \times -0.75)}{0.084 \times (-0.75)}\right\}$$

$$C = 3417.9\ Jkg^{-1}K^{-1}$$

The specific heat capacity of liquid L is 3417.9 $Jkg^{-1}K^{-1}$

Task 02

The aim of this experiment is to determine the specific heat capacity of the oil provided by the method of cooling.

Proceed as follows:-

Practice 01

The aim of this experiment is to determine the specific heat capacity of oil under normal surrounding

Proceed as follows

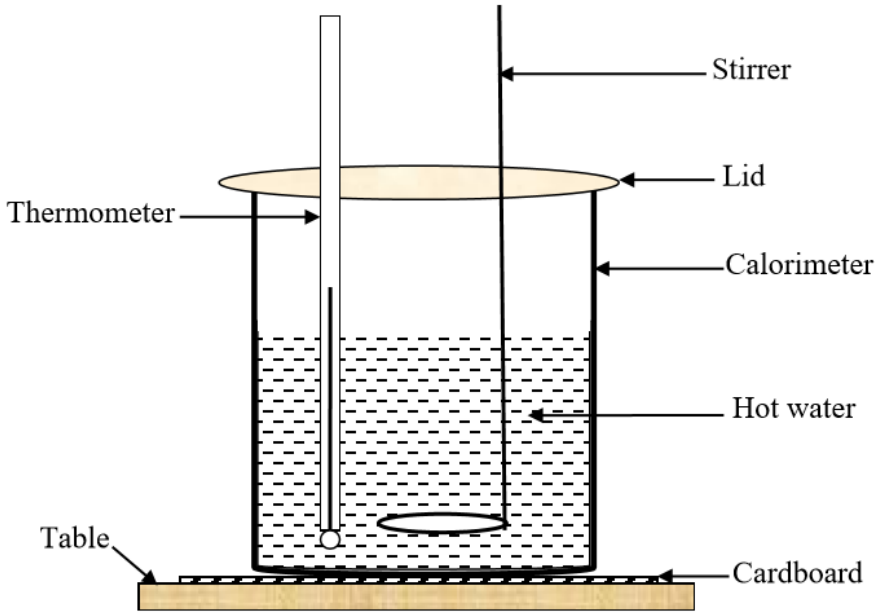
(i) Add some water into the beaker, place the large mass measure it and heat the water until it boils
(ii) Weigh the calorimeter , fill it about one-half with the oil and reweigh ,take the oil temperature
(iii) Take the temperature of the boiling water and then quickly transfer the large mass to the oil
(iv) Observe the time taken for the oil to reach maximum temperature and then find the temperature drops in half this time.
(v) Tabulate the values and determine the specific heat of the oil (Specific heat capacity of water $= \ 4200\ \text{Jkg}^{-1}\text{K}^{-1}$ and specific heat capacity of calorimeter = 380 $\text{Jkg}^{-1}\text{K}^{-1}$)
(vi) What is possible error, if there is any?

Question 22

You are provided with a calorimeter, stirrer, thermometer, source of heat, stop watch, measuring cylinder, 250cm^3 beaker and water bath respectively.

Proceed as follows:

(a) Read and record room temperature θ_R
(b) Measure 100cm^3 of hot water using measuring cylinder and transfer into calorimeter
(c) While stirring record the time taken by the liquid to cool starting a stop watch when the temperature is 80℃.
(d) Record the temperature θ℃after every 2 minutes interval until the time is 20 minutes.



Initial room temperature θ_1 =23◦C Finial room temperature θ_2 =23◦C

Average rom temperature

$$\theta_0 = \frac{\theta_2 + \theta_1}{2} = \frac{23+23}{2} = 23℃, \theta_0 = 23℃$$

(i) Table of results experimentally

Time t(min)	Temperature θ(℃)	$\theta - \theta_0$(℃)	Log($\theta - \theta_0$)
0	80.0	57	1.76
2	76.0	53	1.72
4	73.0	50	1.69
6	69.0	46	1.66
8	67.0	44	1.64
10	65.0	42.0	1.62
12	63.0	40.0	1.60
14	60.5	37.5	1.57
16	58.5	35.5	1.55
18	56.0	33.0	1.52
20	54.0	31.0	1.49

(iii) Rate of change $= M_w C_w \frac{d\theta}{dt}$

Where $M_0 = 30.2g$

$M_1 = 127.6g \quad M_w = M_1 - M_0$

$M_w = 127.6g - 30.2g = 97.4g$

$C_w = 4200J/Kg\,K$

Hence

$$Q = M_w C_w \frac{d\theta}{dt} = 0.0974 \times 4200 \times 0.2 = 81.82J/Sec$$

(iv) The aim of experiment was to determine the rate of heat loss/gain of water

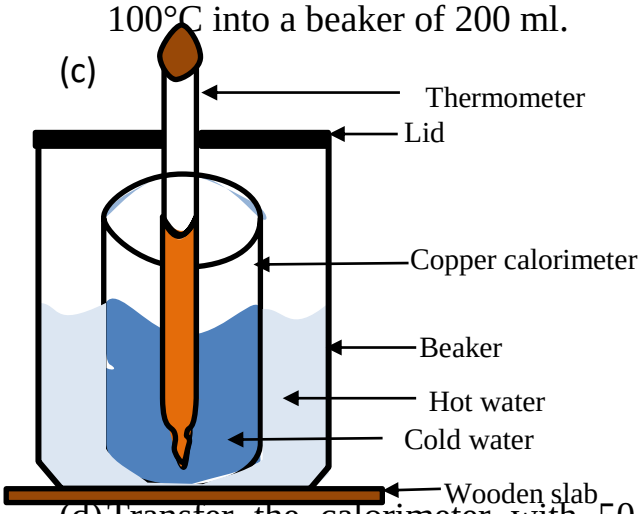
Question 28

In this experiment you are required to investigate thermal properties of liquid in different materials. You are provided with copper calorimeter and glass beaker. Proceed as follows:-

(a) Pour 50 ml of water at room temperature into the copper calorimeter.

(b) Pour 100 ml of hot water of about 100°C into a beaker of 200 ml.

(c)



(d) Transfer the calorimeter with 50 ml of water into the beaker containing hot water when the temperature of hot water is about 100°C and immediately start the stop watch. Read and record the temperature of water in the calorimeter after every 10 seconds as shown in the table in part d (i).

(e) Repeat procedures 2 (a), (b) and (c) by using 50 ml of water poured in 100 ml beaker.

Questions

(i) Complete the table of result below:-

Time t(sec)	θ°C for liquid calorimeter	θ°C for liquid in Beaker
0		
10		
20		
30		
40		
50		
60		
70		

80		
90		
100		

(ii) On the same set of axes, plot a graph of temperature θ(℃) against time t(sec) for each experiment performed.

(iii) From each curve, determine the time taken for the temperature to reach 50℃

(iv) From the results obtained in 2 (iii) above, with reason identify the materials (copper or beaker) with higher specific heat capacity.

Solution for Question 28

(d) (i) table of results

Time t(sec)	θ℃ for liquid calorimeter	θ℃ for liquid in Beaker
0	28	28
10	38	32
20	50	37
30	56	44
40	62	48
50	65	51
60	67	54
70	69	56
80	70	58
90	71	59
100	71	60

(i) From the graph in part (ii) below

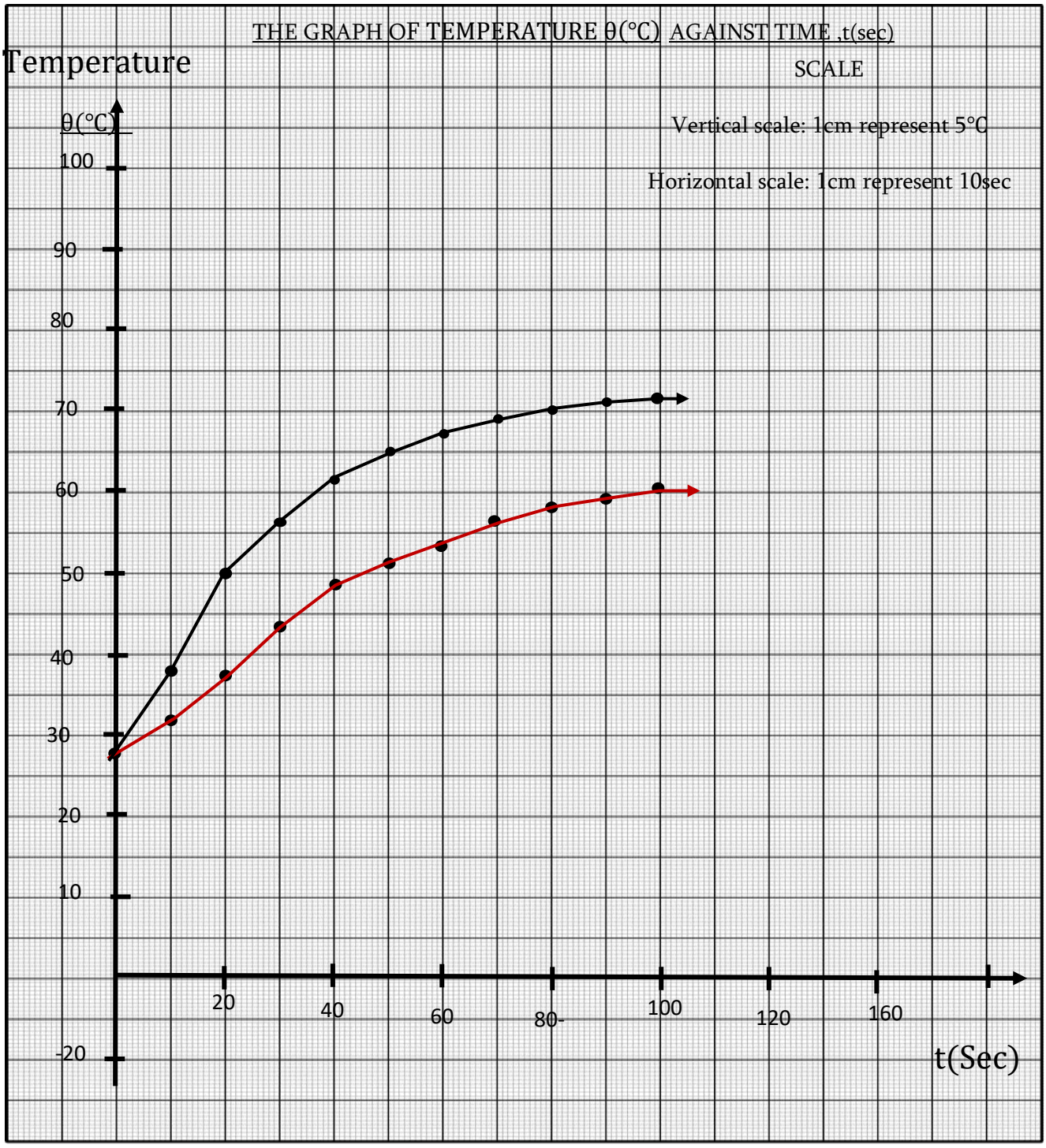
In copper the time is $t_c = 20$ sec

In beaker, the time is $t_b = 45$ sec

(ii) Copper calorimeter is a conductor of heat and has a very low specific heat capacity (400J/kgK)

Due to the lower specific heat capacity it readily reach the equilibrium temperature by absorbing much heat from the hot liquid within a short period of time.

(iii) The graph of temperature (θ℃) against t (sec).



Key

Temperature for liquid calorimeter

Temperature for liquid in Beaker

1. You are required to determine the unknown resistances labeled X using a meter bridge circuit.
   Procedures as follows

   (a) Connect your circuit as shown below, where R is a resistance box is a galvanometer, J is a jockey and other are common circuit components

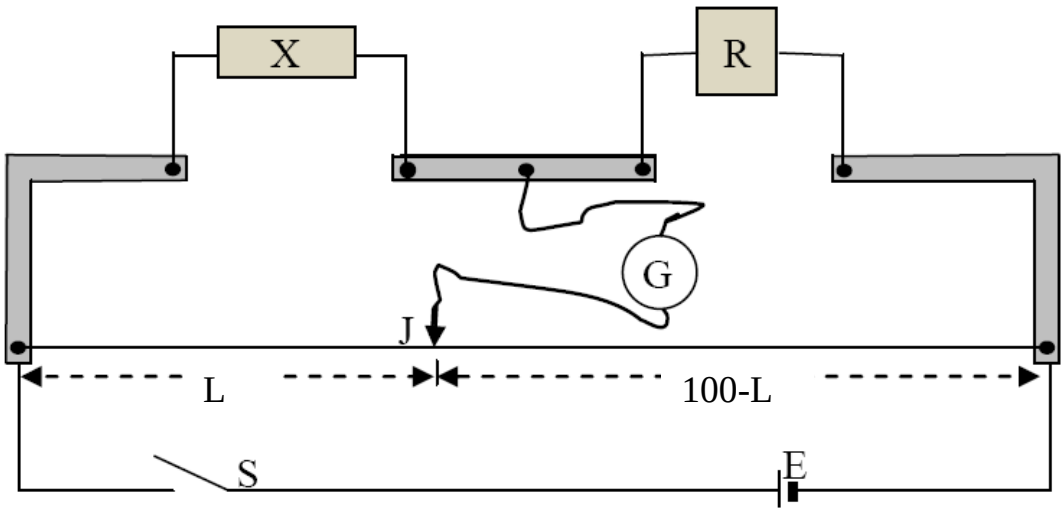


Figure 2

   (b) With R = 1Ω, obtain a balance point on the metre bridge wire AB using a jockey J. Note the length L in centimeters.

   (c) Repeat the experiment with R equal to 2 Ω 4 Ω, 7 Ω, and 10 Ω

   (d) (i) Tabulate your results for R, L and $\frac{1}{L}$

   (ii) Plot a graph of R against $\frac{1}{L}$

   (iii) Determine the slope S of your graph

   (iv) Using your graph, find the value of x Given that $R = \frac{100}{L}X - X$

Solution

From

$$\frac{X}{L} = \frac{R}{100 - L}$$

$$(100 - L)X = RL$$

$$100X - XL = RL$$

$$100X = RL + XL$$

$$100X = L(R + X)$$

$$L = \frac{100X}{R + X}, where\ X = 4\Omega$$

$$For\ R = 1\Omega$$

$$L = \frac{100 \times 4}{1 + 4} = 80cm$$

$$For\ R = 2\Omega$$

$$L = \frac{100 \times 4}{2 + 4} = 66.7cm$$

$$For\ R = 3\Omega$$

$$L = \frac{100 \times 4}{3 + 4} = 57.1cm$$

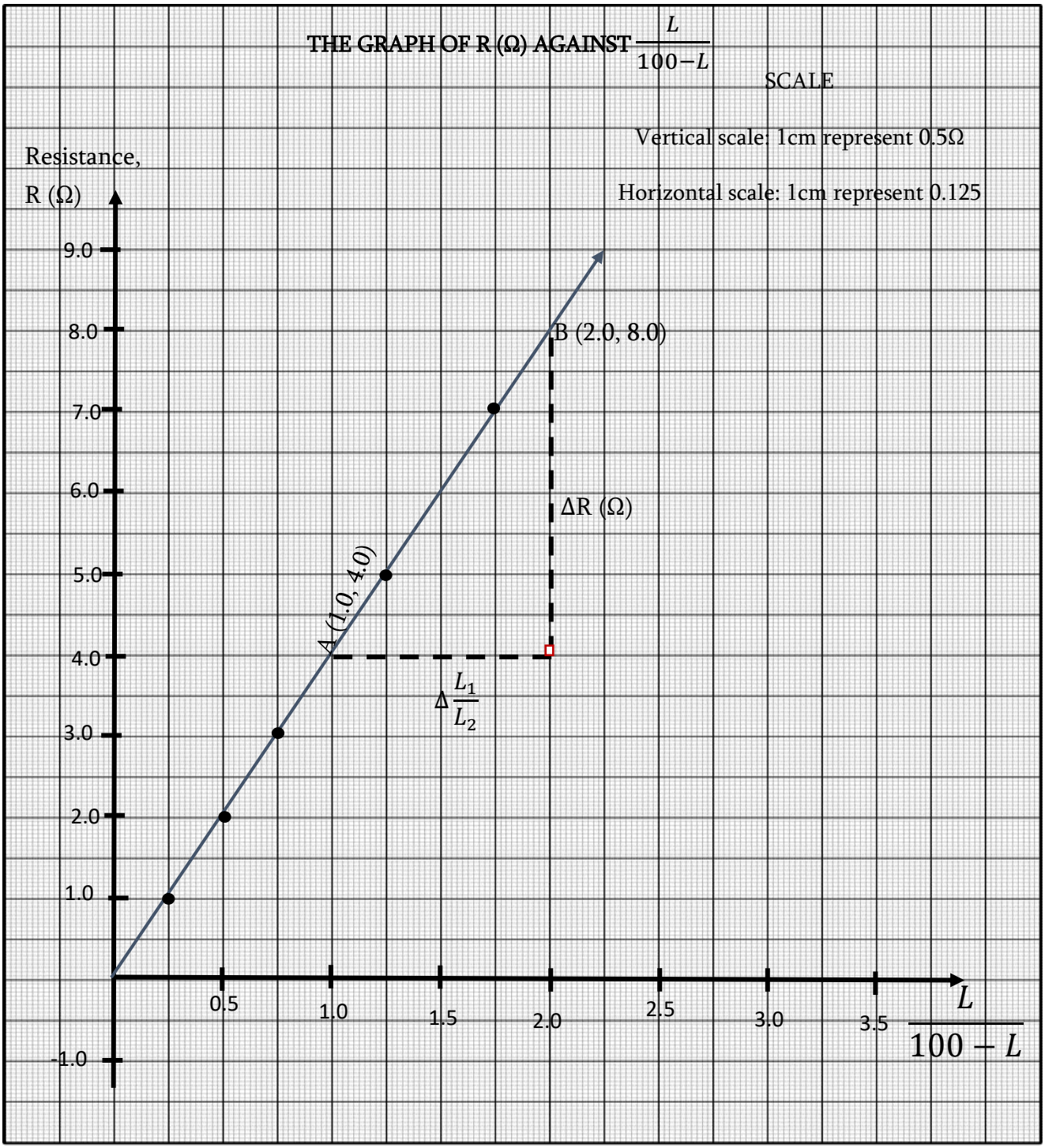
$$For\ R = 5\Omega$$

$$L = \frac{100 \times 4}{5 + 4} = 44.4cm$$

i. Tabulate your results including the values of $\frac{L_1}{L_2}$

R(Ω)	1	2	3	5	7
L(cm)	80.0	66.7	57.0	44.5	36.5
100-L(cm)	20.0	33.3	43.0	55.5	63.5
$\frac{L}{100 - L}$	0.25	0.50	0.75	1.25	1.74

(i) The graph of R against $\frac{L}{100-L}$



(i) From the graph

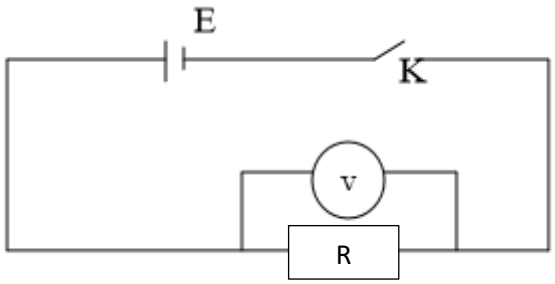
$$\text{Slope M}=\frac{\Delta R(\Omega)}{\Delta\frac{L}{100-L}}$$

Point to consider A (1.0, 4.0) and B (2.0, 8.0)

13. The aim of this experiment is to determine the e.m.f find the internal resistance of a given dry cell.

Proceed as follows

(a) Set up the electric circuit as shown below



Where K = key, E – dry cell e.m.f, V = voltmeter, R – resistor box

(b) Starting with a resistor R = 10Ω and the key closed, record R and the reading V of the volmetre.

(c) Repeat the procedure in (b) above for values of R equals to 5Ω, 4Ω, 3Ω, 2Ω.

(d) (i) tabulate the result including $\frac{1}{R}$ and $\frac{1}{V}$

(ii) Plot the graph of $\frac{1}{R}$against $\frac{1}{V}$

(iii) Determine slope of your graph and its y- intercept

(iv) Determine the emf and internal resistance r by showing clear your solution from the graph

Solution question 12

Way to obtain data

From $E - I(R + r), I = \frac{E}{R+r}$ then

From ohm law

$$V = IR, But\ I = \frac{E}{R + r}$$

$$V = \left(\frac{E}{R + r}\right)R$$

$$\frac{1}{V} = \left(\frac{\mathrm{R}+\mathrm{r}}{E}\right)\frac{1}{R}.\frac{1}{V} = \frac{1}{E} + \frac{\mathrm{r}}{ER}$$

$$\frac{1}{V} = \left(\frac{\mathrm{r}}{E}\right)\frac{1}{R} + \frac{1}{E}$$

$$\begin{array}{cccccc} \frac{1}{V} & = & \frac{\mathrm{r}}{E} & \frac{1}{R} & + & \frac{1}{E} \\ \uparrow & & \uparrow & \uparrow & & \uparrow \\ y & & m & x & & +c \end{array}$$

Then

$$\mathrm{V} = \left(\frac{\mathrm{E}}{\mathrm{R}+\mathrm{r}}\right)\mathrm{R}.\,\mathrm{E} = 1.5\mathrm{V}, \mathrm{r} = 0.5\Omega \text{ for a single cell}$$

For $\mathrm{R} = 10\Omega$

$$\mathrm{V} = \left(\frac{1.5}{10+0.5}\right) \times 10 = 1.4\mathrm{v}$$

For $\mathrm{R} = 10\Omega$

$$\mathrm{V} = \left(\frac{1.5}{10+0.5}\right) \times 10 = 1.42\mathrm{v}$$

For $\mathrm{R} = 5\Omega$

$$\mathrm{V} = \left(\frac{1.5}{5+0.5}\right) \times 5 = 1.36\mathrm{v}$$

For $\mathrm{R} = 4\Omega$

$$\mathrm{V} = \left(\frac{1.5}{4+0.5}\right) \times 4 = 1.33\mathrm{v}$$

For $\mathrm{R} = 3\Omega$

$$\mathrm{V} = \left(\frac{1.5}{3+0.5}\right) \times 3 = 1.29\mathrm{v}$$

For $\mathrm{R} = 2\Omega$

$$\mathrm{V} = \left(\frac{1.5}{2+0.5}\right) \times 2 = 1.20\mathrm{v}$$

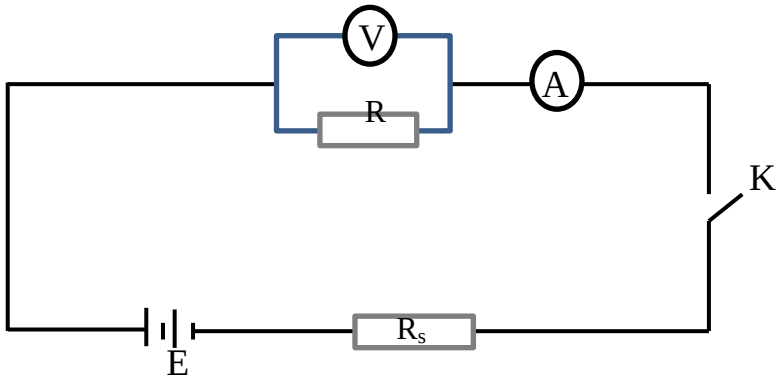
(i) Table of results

R(Ω)	V	$\frac{1}{R}(\Omega^{-1})$	$\frac{1}{V}(V^{-1})$
10	1,42	0.10	0.70
5	1.36	0.20	0.74
4	1.33	0.25	0.75
3	1.28	0.33	0.78
2	1.20	0.50	0.83

14. You are provided with a battery E, a key K, ammeter A, Voltmeter V, resistance box S, unknown resistance R and pieces of connecting wires.

Proceed as follows;

(a) Connect the given components in a series except the voltmeter which should be connected in parallel with the unknown resistor as shown in figure below



(b) Set the resistance of 10Ω in a resistance box. Close the key and record the readings of the ammeter and voltmeter.

(c) Repeat the procedures in 1 (b) each time by setting the resistance to 15Ω, 20 Ω, 25 Ω, and 30 Ω.

Questions

(i) Tabulate the results obtained in 1(b) and (c).

(ii) Plot a graph of Voltage (V) against Current (I).

(iii) Compute the value of the unknown resistance.

Solution question 13

Way to obtain data

From ohm law

$V = IR$, but R is unknown resistor which is 2Ω

Thus for $I = 0.1A$ $V = 0.12 \times 2 = 0.24V$

$V = 0.2 \times 2 = 0.4V$ Thus for $I = 0.1A$

Thus for $I = 0.3A$ $V = 0.1 \times 2 = 0.2V$

$V = 0.16 \times 2 = 1.32V$ Thus for $I = 0.7A$

Thus for $I = 0.5A$ $V = 0.o9 \times 2 = 0.18V$

(i) Table of results

Rs (Ω)	10	15	20	25	30
I (A)	0.20	0.16	0.12	0.10	0.09
V(V)	0.40	0.33	0.24	0.20	0.18

From the graph, the slope $S=\frac{\Delta V(Volts)}{\Delta I(A)}$

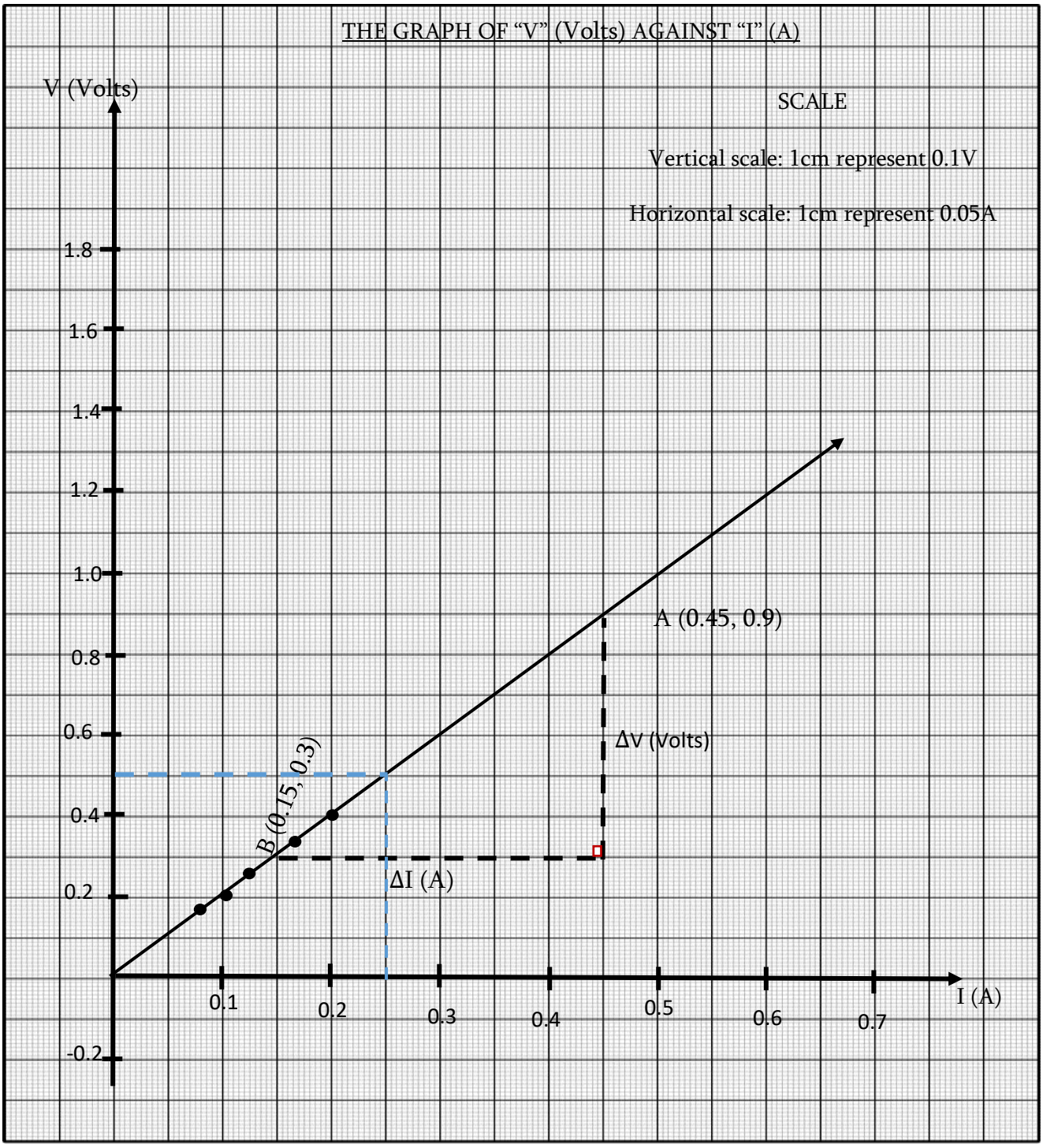
Point to from the graph A (0.45, 0.9) and B (0.15, 0.3)

$S=\frac{0.9-0.3}{0.45-0.15}\frac{(V)}{(A)} = \frac{0.6}{0.3} = 2\Omega$

The Slope, S, of the graph is2Ω

The unknown resistance is $2\ \Omega$

(ii) The graph of V against I


THE GRAPH OF "V" (Volts) AGAIN$T "I" (A)
V (Volts)
SCALE
Vertical scale: 1cm represent 0.1V
Horizontal scale: 1cm represent 0.05A
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
-0.2
A (0.45, 0.9)
B (0.15, 0.3)
ΔV (Volts)
ΔI (A)
0.1
0.2
0.3
0.4
0.5
0.6
0.7
I (A)

$$\frac{1}{I} = \frac{1}{3}(5+1) = 2$$

$$I = 0.5A$$

Table of results

Resistance R(Ω)	1	2	3	4	5
Current I(A)	0.67	1.00	1.33	1.67	2.00
$\frac{1}{I}(A^{-1})$	1.50	1.00	0.75	0.60	0.50

Nature of the graph

From

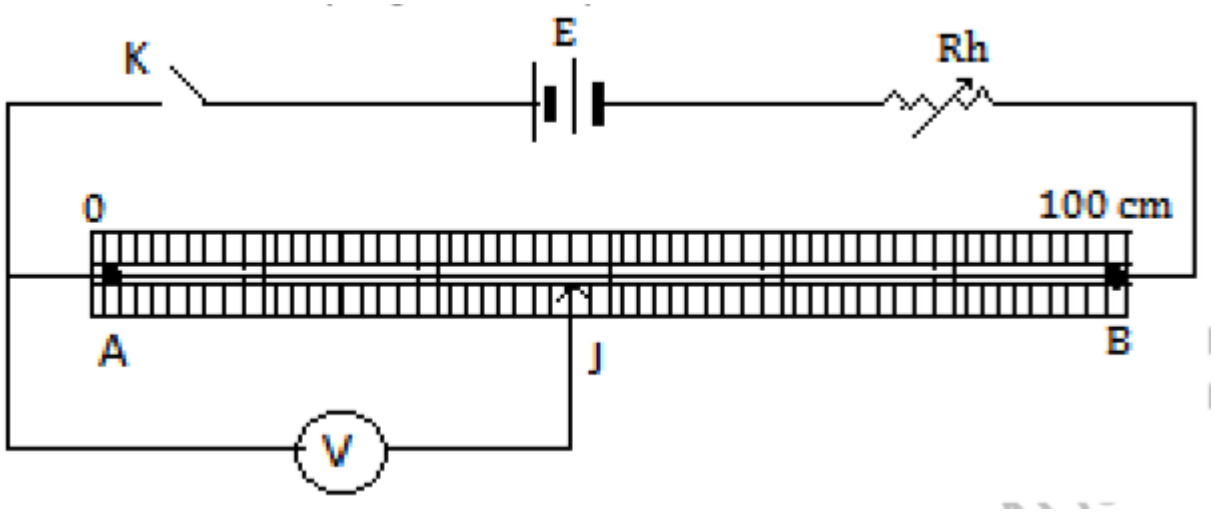
$$\frac{1}{I} = \frac{R}{E} + \frac{r}{E}$$

$$R = (E)\ \frac{1}{I} - r \quad \uparrow C$$

$$y = m\ x$$

Thus the graph have positive slope and pass through at negative $R - intercept$

17. The aim of this experiment is to determine the potential fall along the resistance wire carrying a steady current. Proceed as follows



(a) Connect up the circuit as shown in the diagram.

(b) Adjust the rheostat so that when the sliding contact J is near B and the key K is closed, the voltmeter V indicates an almost full scale deflection.

(c) Do not alter the rheostat again. Close the key K and make contact with jockey J such that $X = 10cm$. Record the potential difference V between A and J as registered on the voltmeter.

(d) Repeat the procedure for $X = 20cm, 30cm, 50cm, 70cm$ and $90cm$

(e) (i) Tabulate your results for the values of V and x.

(ii) Plot a graph of V (vertical axis) against the values of x (horizontal axis)

(iii) Calculate the slope, "S". What is your comment about the slope obtained above?

(iv) Find determine the potential fall along the resistance wire carrying a steady current

Answer question 16

Way to obtain data

From $V = IR$ and $R = \frac{\rho L}{A}$

Since the current is steady $\frac{V}{L} = I = K - slope$, thus$V = \frac{\rho x}{A}$

Then for $X = 10cm \cong 0.1m$, SWG 28, $A = 1.134 \times 10^{-7} m^2, \rho = 4.9 \times 10^{-7} (\Omega m)$ for constantain wire

$$V = \left(\frac{4.9 \times 10^{-7} (\Omega m) \times 0.1}{1.134 \times 10^{-7} m^2} \right) \times 1A$$

NECTA 2022, 3A

1. You are provided with a wire W meter rule, two cork pads, test tube, micrometer screw gauge, slotted mass of 20g, retort stand with its accessories, masking tape and optical pin.

Proceed as follows;

(i) Measure and record the length l and diameter d of the wire **W**.

(ii) Wind the whole length of the wire W tightly on the test tube such that the turns are as close as possible but not overlapping.

(iii) Measure the length x of the coil made as shown in Figure 1 and count the number of turns.

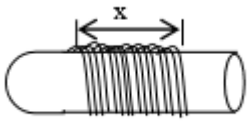


Figure 1

(iv) Remove the coil from the test tube; straighten the first and the last coil. Clamp one end on the retort stand while bending the other end to make a hook. Count the number of complete turns (n) remaining and measure the distance h_1 between the ends of the coil as shown in Figure 2.

(v) Load a 20 g mass on the other end of the coil and arrange as shown

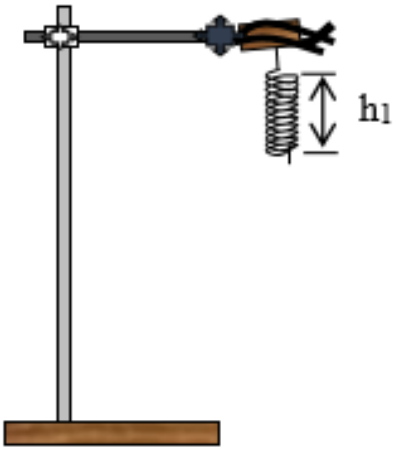


Figure 2

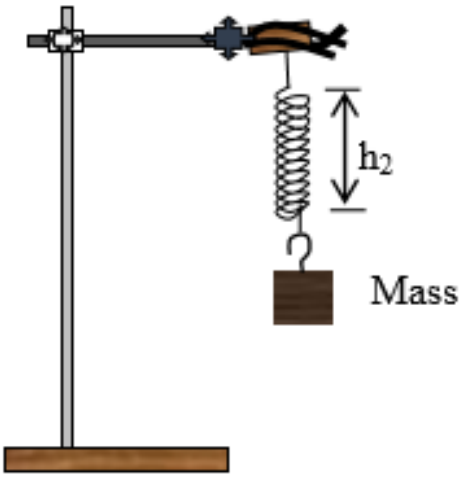


Figure 3

in Figure 3. Measure and record the distance h_2 between the ends of the turns.

(vi) Remove the mass, reduce the number of turns by straightening three turns of the coil from the upper end and adjust the point of suspension of the coil. Record the number of turns (n) remaining and measure the distance h1. Load 20 g mass of the coil and then measure and record distance h_2.

(vii) Repeat the procedures in 1 (f) so as to obtain the other three readings to make a total of five readings for n, h_1 and h_2.

Questions

(i) Record the values of n, h1 and h2 and find extension e as shown in the following table:

Number of turns n remaining					
Distance h_1(cm)					
Distance h_2(cm)					
Extension,$e = (h_1 - h_2)$)(cm)					

(ii) Plot the graph of extension, e against the number of turns, n.

(iii) Determine the slope S of the graph.

(iv) Compute the value of constant G from the equation $\frac{1}{n} = \frac{GX}{de}$

Solution for NECTA 2022, 3A, question1

Wire given, W-constantan wire with SWG, 26

Their diameter (d) is 0.46mm

Length of given wire, W=96cm

(i) Table of results

Number of turns n remaining	15	12	9	6	3
Distance h_1(cm)	10	9	7	5	2
Distance h_2(cm)	15	13	10	7	3
Extension,$e = (h_1 - h_2)$)(cm)	5	4	3	2	1

(iii) The slope, m, from the graph

Slope, m=$\frac{\Delta e(Cm)}{\Delta n}$

Point to from the graph A (10.5, 3.5) and B (4.5, 1.5)

$$m=\frac{3.5-1.5}{10.5-4.5}=\frac{2}{6}=0.33cm$$

The Slope, m, of the graph is 0.33cm

(iv) From the equation

$$\frac{1}{n}=\frac{GX}{de},$$

$$e=\frac{nGX}{d}$$

$$e = \frac{(GX)}{d}n + 0$$

$$\uparrow \quad \uparrow \quad \uparrow$$

$$y = m\,x + C$$

So, slope m=$\frac{GX}{d}$

Where d-diameter of wire =0.46mm=0.046cm

X-length of a wire =95cm, M-slope=0.33cm

Then,$G = \frac{dm}{x} = \frac{0.046cm \times 0.33cm}{95cm} = 1.5 \times 10^{-4} cm/turns$

The value of G=$1.5 \times 10^{-4} cm/turns$

(ii) The graph of e (cm) against n.

2. Form Five Physics students were debating on whether hot objects made with the same materials but having different masses have the same rate of cooling or not. The candidates were required to conclude their debate by performing the experiment using the following procedures:
   (a) Measure the mass of empty calorimeter provided.
   (b) Fill the calorimeter with hot water of 90 °C to three quarters and then cover the calorimeter with a lid.
   (c) While fanning hard board, record the time (t) in seconds for every 5°C drop of temperature of water starting from the temperature of 80 °C to 55°C.
   (d) Record the mass of the calorimeter with water.
   (e) Repeat procedure (c) to (d) when the calorimeter is half filled with hot water.

Questions

(i) Tabulate the results obtained in (c) and (e).
(ii) Determine the mass of water m_1 and m_2 as obtained from procedures in (a) and (e) respectively.
(iii) Plot the graph of time obtained in (c) against that in (e).
(iv) Determine the slope of the graph plotted in (iii).
(v) Determine the ratio of the masses m1 and m2.
(vi) Use the slopes and the ratio of masses obtained from the experiment to conclude the debate of the students.

Solution

Mass of an empty calorimeter $m_0 = 37.8g$

Mass of calorimeter with hot water $m_1 = 112.8g$

Mass of calorimeter with cold water $m_2 = 88.8g$

Room temperature =16.5℃

(i) Table of results for calorimeter with water three quarter

Solution question 3

(i) Its diagram.

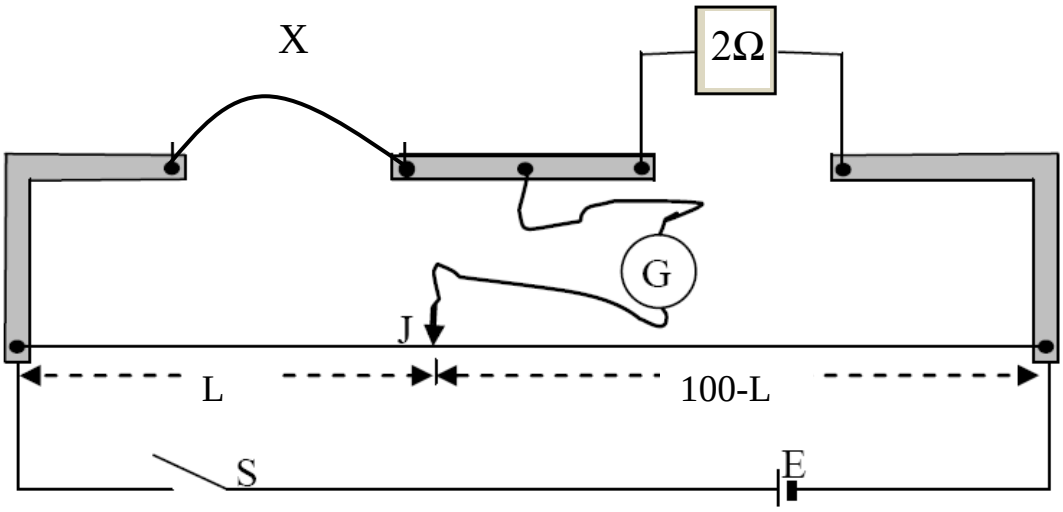


Figure 2

Way to obtain answer

From

$$\frac{R_X}{L} = \frac{2\Omega}{100 - L} \; and \; \rho = \frac{AR_X}{X}$$

Where A-cross section area of given wire, X-distance of wire given, $R_X - resistance\ of\ wire\ X$

Thus, the Wire X, given was constantan wire with SWG 28, its diameter was 0.38mm, hence,

$$\text{A}=\frac{\pi d^2}{4} = \frac{3.14\times\left(0.38\times10^{-3}\right)^2}{4} = 1.13 \times 10^{-7} m^2 \text{ and}$$

$$\rho = 4.9 \times 10^{-7}\Omega m. - the\ resisitivity\ of\ constantain\ wire$$

$$\text{Then } R_x = \frac{\rho X}{A}$$

When x=15cm=0.15m

$$R_x = \frac{\rho X}{A} = \frac{4.9\times10^{-7}\times0.15}{1.13\times10^{-7}} = 0.65\Omega$$

PHYSICS 3B, 2022

1. Suppose the weighing balance at school is not working properly you are required to determine the mass of the empty glass beaker

Proceed as follows

(a) Using the masking tape to firmly wrap the thread on the beaker and suspend it to the lower end of the spring as shown in Figure 1 where an optical pin is bent into 'S' shape.

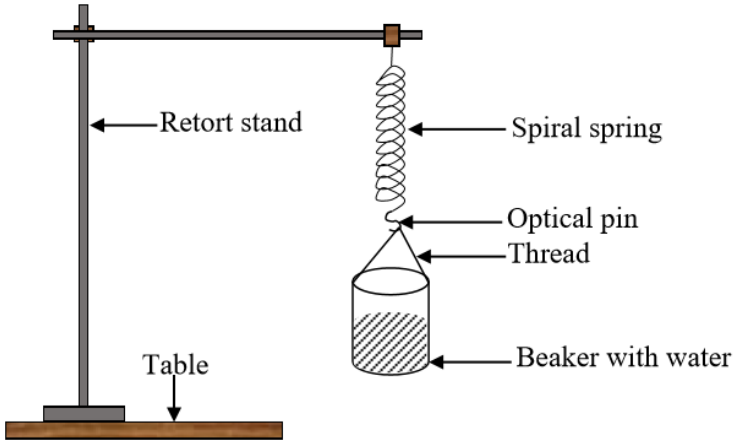


Figure 1

(b) Measure the volume V =25 cm^3 of water and pour it into the suspended beaker. Gently pull the beaker a small distance downward and release it so that it performs vertical oscillations. Measure and record time t (s) for 30 oscillations and determine periodic time, T.

(c) Repeat the procedure in 1 (b) for V =60 cm^3, 100cm^3, 150cm^3 and 200 cm^3.

Questions

(d) (i) Tabulate your results including the values of T^2 (s2).

(ii) Plot a graph of V (cm^3) against T^2 (s^2).

(iii) Establish the equation governing this experiment

(iv) Use the graph and the equation obtained in 1 (iii) to determine the mass of an empty glass beaker.

(v) What will happen to the floating object if it is put in oscillating beaker at the bottom position of its oscillation? Briefly explain

Solution

2. Hotel owner heats water for his customer every morning using electric heater and notes that, heat is lost because sometime customers do not take bath. Therefore, he is aiming to use heat obtained from the heated water for other purposes. Performing an experiment to prove to him that he heated water can also be used to heat other liquids.

Proceed as follows;

(a) Fill the beaker with 100 ml of hot water of about 90 °C.

(b) Pour 50 ml of normal water (at the room temperature) into a calorimeter.

(c) Insert the calorimeter containing normal water into a beaker with hot water of 85 °C placed on a wooden block. Quickly close the beaker with lid as shown in Figure 2.

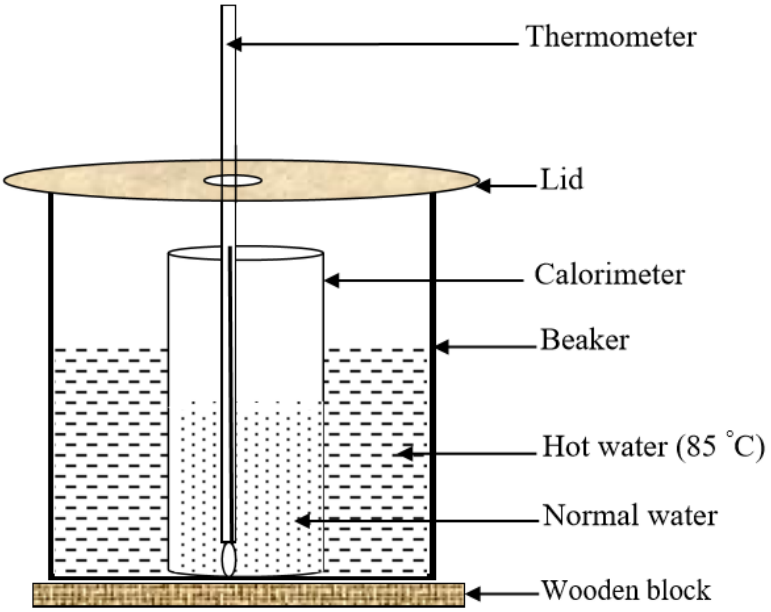


Figure 2

(d) Read and record the temperature of water in the calorimeter for every half minute until the thermometer records about 55 °C.

(e) Empty the calorimeter and the beaker.

(f) Repeat the procedure from (a) to (d) by filling the calorimeter with 50 ml of liquid **L**.

Questions

(i) Tabulate your results.

(ii) Plot the graph of temperature against time for water and liquid L on the same axes.

(iii) Determine the rate of temperature rise (°C/minute) for water and liquid L at 42 °C.

(iv) Suggest any two improvements that will result into increase in the temperature gained by liquid **L**.

Solution

NECTA 2021, 3A

1. The aim of this experiment was to investigate the variation of length, L of the thread with the periodic time, T of simple pendulum. Proceed as follows;

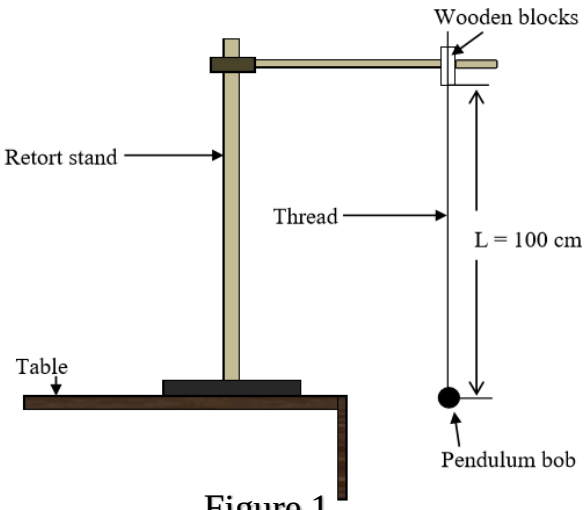


Figure 1

(a) Set up the apparatus as shown in Figure 1

(b) Displace the pendulum through a small angle then release it so that it moves to and fro motion with small amplitudes. Measure and record the time, t for 10 complete oscillations and hence determine its periodic time T.

(c) Repeat the procedure in 1 (b) for the values of L = 80 cm, 50 cm, 40 cm and 15 cm.

Questions

(i) Use the dimensional analysis to find the value of n from the equation, $L=kT^n$; where k is in cms^{-1}.

(ii) Tabulate the results obtained in 1 (b) and (c) including the value of T^n.

(iii) Use the equation in 1 (i) and the results obtained in (ii) to determine the value of k graphically.

(iv) Compute the value of C, given that $c = \frac{g}{k}$ where g is the acceleration due to gravity.

(v) Determine the deviation of value of C (ΔC) from the true value.

(vi) Calculate the percentage error in performing this experiment

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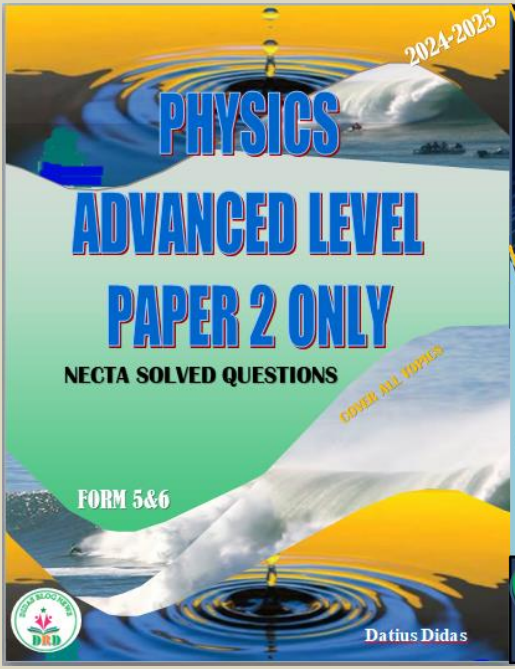
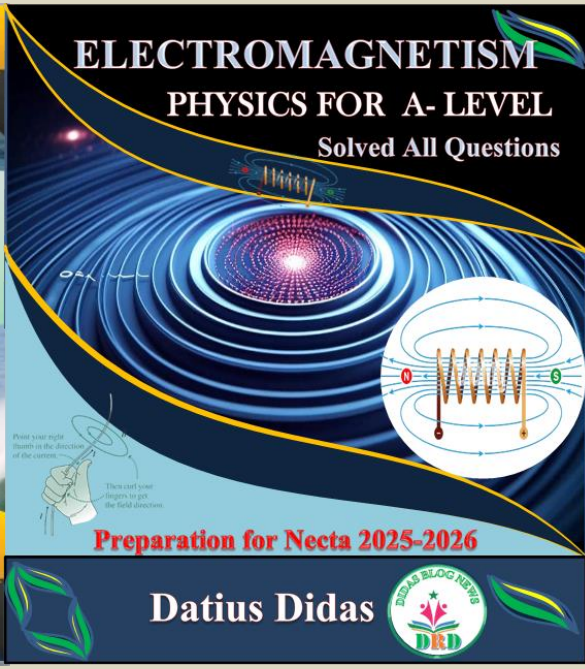
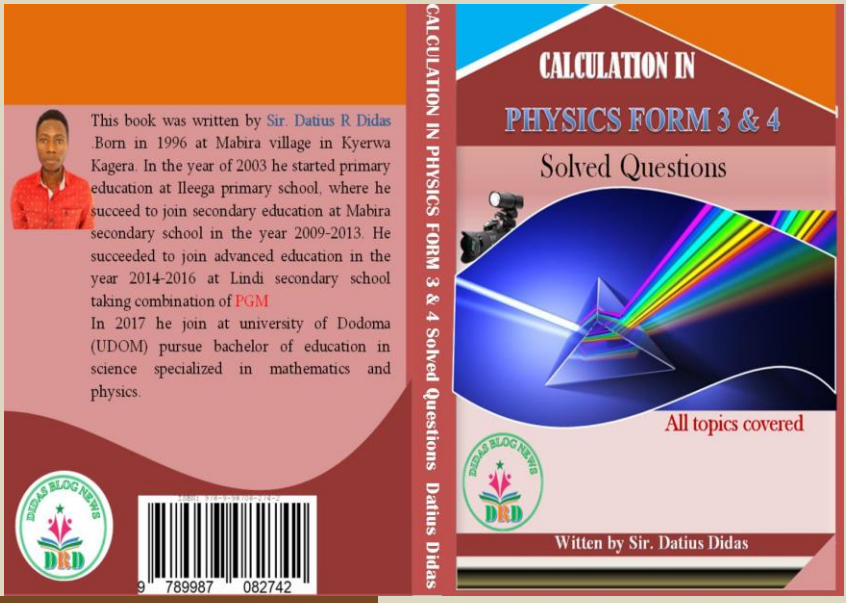
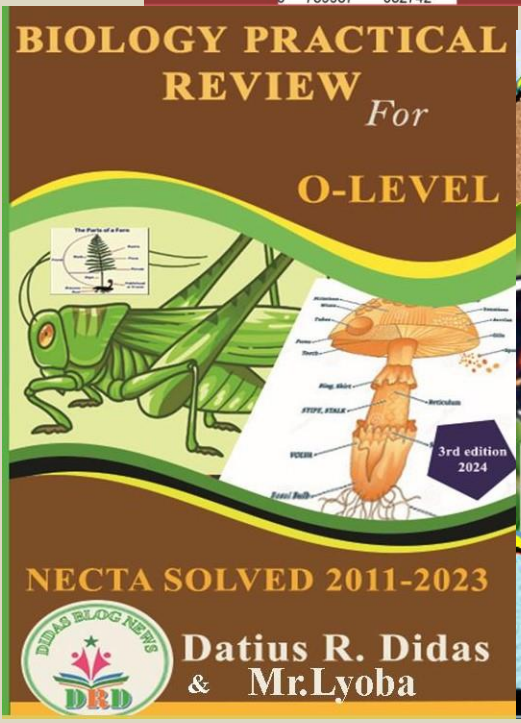
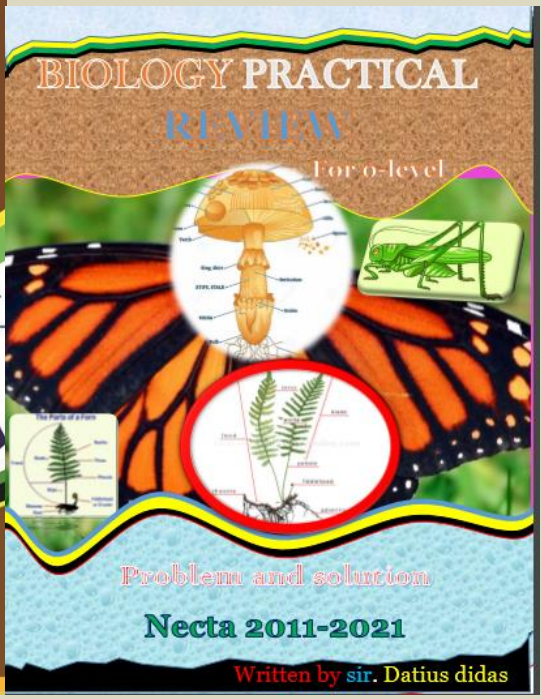




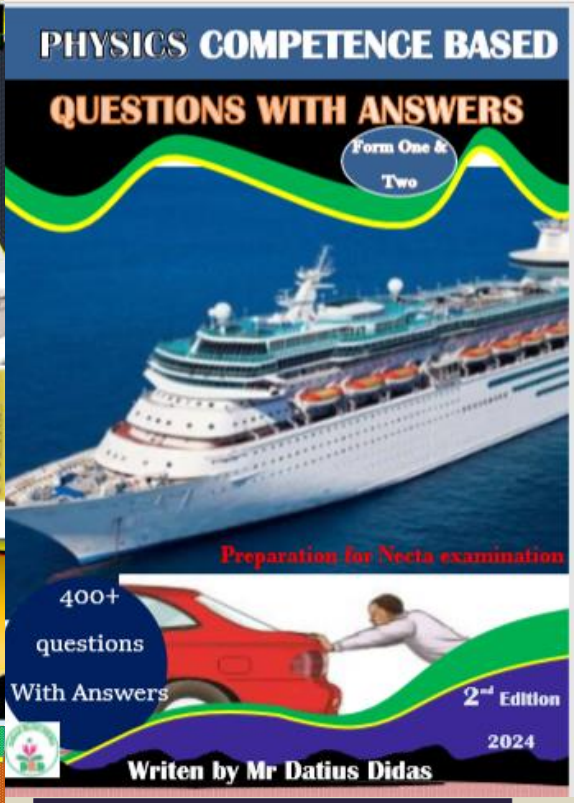
ELECTROMAGNETISM FORM SIX QUESTION'S WITH ANSWER'S

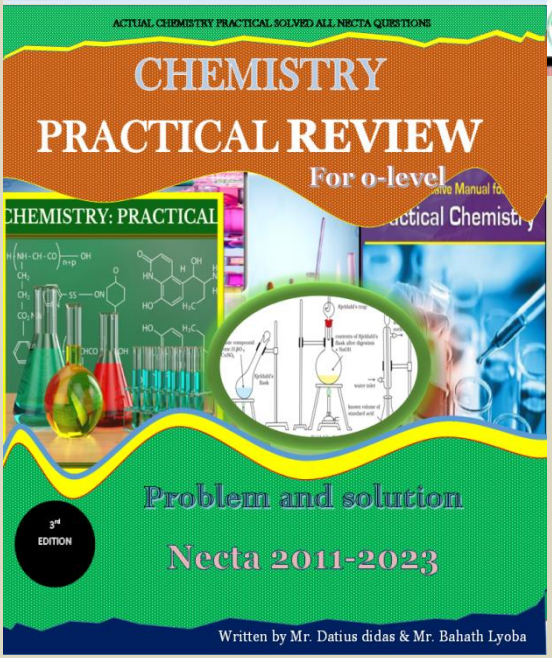


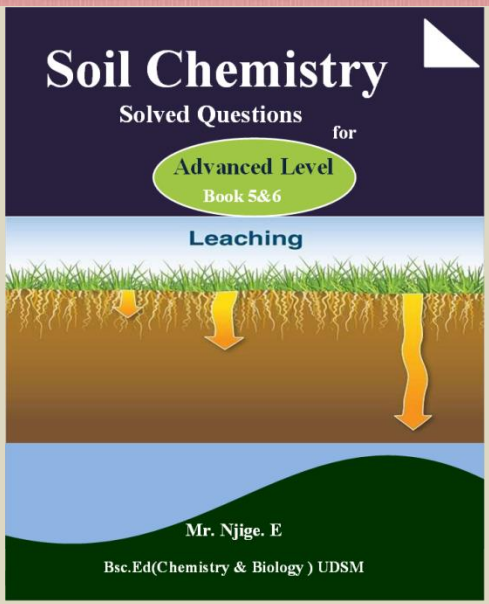




ELECTROMAGNETISM FORM SIX QUESTION'S WITH ANSWER'S







Physics Practical

Solved Question's for

Advanced Level

Form 5 &6

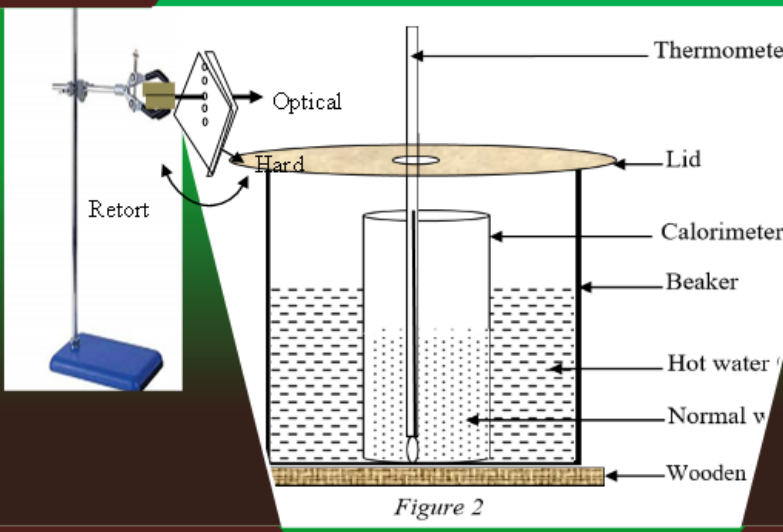


Figure 2

Current Electricity

Mechanics

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Mr. Datius R.Didas

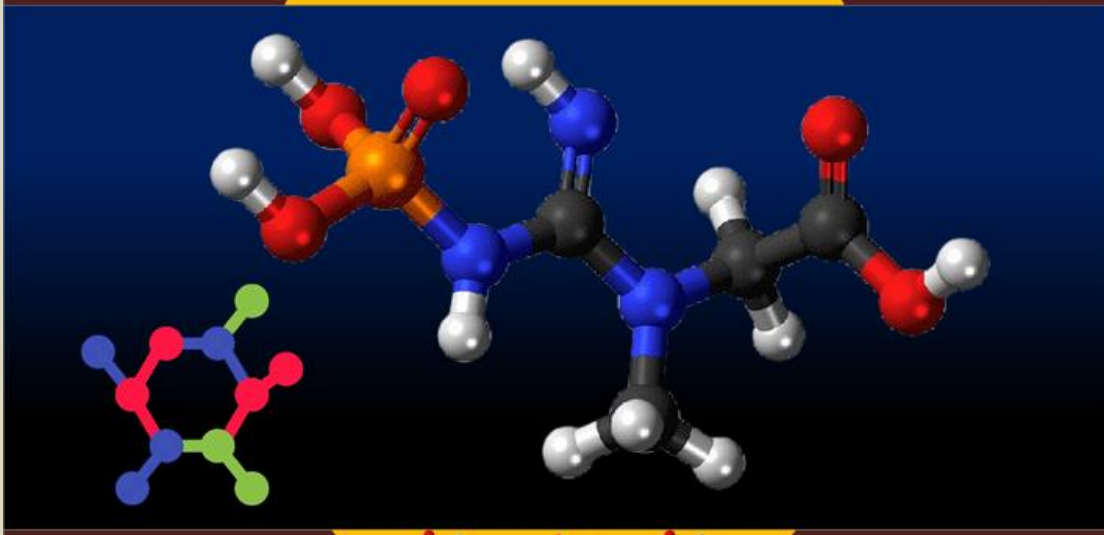
Bed. Sc(Physics & Mathematics) Udom

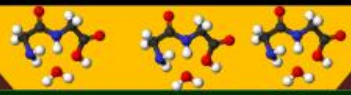
Organic Chemistry

Solved TIE Questions for

Advanced Level

Book 5&6





Mr. Njige. E

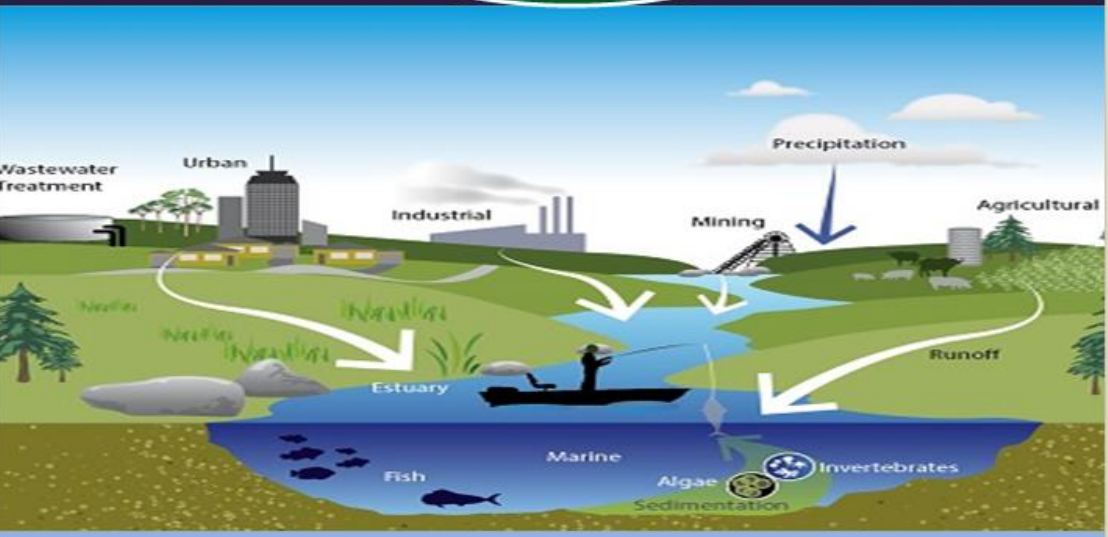
Bsc.Ed(Chemistry & Biology) UDSM

Environmental Chemistry

Solved Questions for

Advanced Level

Book 5&6



Mr. Njige. E & Mr.Didas

Bsc.Ed(Chemistry & Biology) UDSM

VITABU HIVI UTAVIPATA KWA WAHUSIKA TU

MR **DIDAS**

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