

FORMULA :

$$\text{Least count of vernier calliperse} = \frac{\text{length of one mainscale division}}{\text{no.of divisions on vernier scale}}$$

$$= \frac{0.1\text{cm}}{10} = 0.01\text{cm}$$

$$\text{Volume of the sphere } V = \frac{4}{3}\pi r^3 \text{ cm}^3$$

Table 1 : To determine the radius of the sphere :

S.NO	Main Scale reading M.S.R a cm	vernier coincidence n	Fraction b = n x LC cm	Total a+b cm
1	1.8	7	0.07	1.87
2	1.8	8	0.08	1.88
3	1.8	7	0.07	1.87
4	1.8	7	0.07	1.87
5	1.8	8	0.08	1.88
6	1.8	7	0.07	1.87

Diameter of the sphere $d = 1.873 \text{ cm}$ Radius of the sphere $r = 0.9365 \text{ cm}$

Calculation :

$$\text{Volume of the sphere } V = \frac{4}{3}\pi r^3 \text{ cm}^3$$

$$= \frac{4}{3} \times 3.14 \times (0.9365)^3$$

$$= 3.439 \text{ cm}^3$$

Precautions :

Body should be gently fixed between jaws without applying excess pressure.

Readings should be taken without parallax error

Result :

Volume of the sphere $V = 3.439 \text{ cm}^3$

FORMULA :

$$\text{Pitch of the screw} = \frac{\text{Distance moved on pitch scale}}{\text{no.of rotations}} = \frac{5\text{mm}}{5} = 0.01\text{mm}$$

$$\text{Least count} = \frac{\text{Pitch of the screw}}{\text{No.of divisions on head scale}} = \frac{1\text{mm}}{100} = 0.01\text{mm}$$

Error : - 3

Correction : + 3

Table 1 : To determine the radius of given cylinder

SI No	Pitch scale Reading a mm	Head scale reading		Fraction b = n x LC	Total a + b mm
		Observed	Correction n		
1	2	48	51	0.51	2.51
2	2	48	51	0.51	2.51
3	2	47	50	0.50	2.50
4	2	48	51	0.51	2.51
5	2	47	50	0.50	2.50
6	2	48	51	0.51	2.51

Average diameter of the cylinder d = 2.5066 mm

Radius of the cylinder r = 1.2533 mm

Table 2 : To determine the thickness of glass plate :

SI No	Pitch scale Reading a mm	Head scale reading		Fraction b = n x LC	Total a + b mm
		Observed	Correction n		
1	1	18	21	0.21	1.21
2	1	18	21	0.21	1.21
3	1	18	22	0.22	1.22
4	1	18	22	0.22	1.22
5	1	18	21	0.21	1.21
6	1	18	21	0.21	1.21

Thickness of the glass plate t = 1.2133 mm

PRECAUTIONS : Screw should be rotated in one direction to avoid backlash error

Body should be gently fixed between shafts without applying pressure

RESULT : Radius of the cylinder r = 1.2533 mm

Thickness of the glass plate t = 1.2133 mm

FORMULA :

$$\text{Correct mass of the body} = \text{Mass corresponding to HRP} + \left\{ \frac{\text{HRP} - \text{ZRP}}{\text{HRP} - \text{LRP}} \right\} X 0.01 \text{ gm}$$

Where HRP = higher resting point

ZRP = Zero resting point

LRP = Lower resting point

To determine the mass of the body :

Sl no	Contents in pans		Turning points		Mean turning points		Resting point
	Left	Right	Left	Right	Left	Right	
1	-----	-----	2 2 2	18 18	2	18	10 (ZRP)
2	Iron bolt	10.000 2.000 0.500 0.200 0.100 0.020 0.020 ----- 12.840 gm	4 4 4	19 19	4	19	11.5 (HRP)
3	Iron bolt	10.000 2.000 0.500 0.200 0.100 0.050 ----- 12.850 gm	1 1 1	16 16	1	16	8.5 (LRP)

CALCULATIONS :

$$\begin{aligned}
 \text{Correct mass of the body} &= \text{Mass corresponding to HRP} + \left\{ \frac{\text{HRP} - \text{ZRP}}{\text{HRP} - \text{LRP}} \right\} X 0.01 \text{ gm} \\
 &= 12.840 + \left[\frac{11.5 - 10}{11.5 - 8.5} \right] X 0.01 \\
 &= 12.840 + 0.5(0.01) \\
 &= 12.840 + 0.005 \\
 &= 12.845 \text{ gm}
 \end{aligned}$$

$$\text{Volume of the object } V = \frac{\text{mass}}{\text{density}} = \frac{12.845}{7.87} = 1.632 \text{ cm}^3$$

Precautions : Heavy weights should not be added in the pans
Arrest beam during addition or removal of weights

Result : Mass of the given body 12.845 gm
Volume of the body 1.632 cm³

FORMULA :

$$\text{Least count of vernier calliper} = \frac{\text{length of one mainscale division}}{\text{no. of divisions on vernier scale}}$$

$$= \frac{0.1\text{ cm}}{10} = 0.01\text{ cm}$$

$$\text{Acceleration due to gravity } g = 4\pi^2 \frac{l}{T^2} \text{ cm/s}^2$$

Where l – length of the pendulum cm

T – time period of the pendulum sec

$$\text{Percentage error in determine the value of } g = \frac{g' - g}{g} \times 100\%$$

Where g' - calculated value in cm/s^2 g - standard value = 980 cm/s^2

Table 1: To determine the radius of the bob :

Sl no	Main scale reading M S R a cm	Vernier coincidence n	Fraction b = n X LC cm	Total a + b cm
1	1.8	7	0.07	1.07
2	1.8	6	0.06	1.06
3	1.8	7	0.07	1.07

Diameter of the bob d = 1.866 cm

Radius of the bob r = 0.933 cm

Table 2 : To determine the value of $\frac{l}{T^2}$

Sl no	Length of the Pendulum l cm	Time taken for 20 oscillations			Time period T = x/20 s	T^2 S^2	$\frac{l}{T^2}$ cm/s ²
		Trail 1	Trail 2	Mean x			
1	50	29	29	29	1.45	2.102	23.78
2	60	31	32	31.5	1.575	2.48	24.19
3	70	34	34	34	1.7	2.89	24.22
4	80	36	36	36	1.8	3.24	24.69
5	90	38	37	37.5	1.875	3.515	25.6
6	100	40	40	40	2	4	25

Average value of $\frac{l}{T^2} = 24.58 \text{ cm/s}^2$

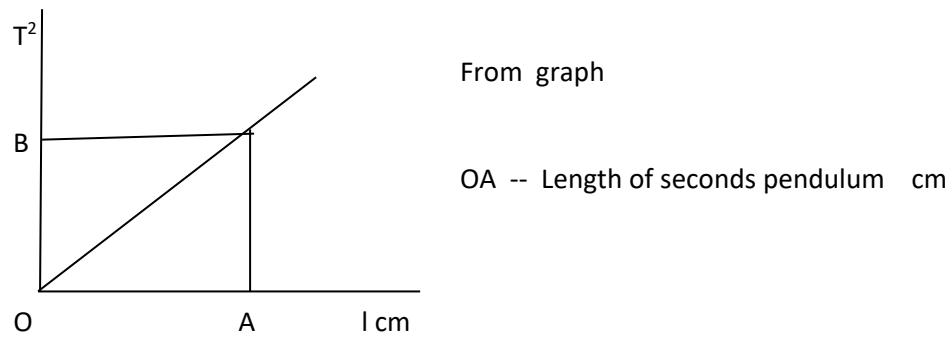
Calculation :

$$\begin{aligned} \text{Acceleration due to gravity } g &= 4\pi^2 \frac{l}{T^2} \text{ cm/s}^2 \\ &= 4 \times 3.14^2 \times 24.58 \\ &= 970.3 \text{ cm/s}^2 \end{aligned}$$

$$\begin{aligned} \text{Percentage error in determine the value of } g &= \frac{g' - g}{g} \times 100\% \\ &= \frac{980 - 970.3}{980} \times 100 = 0.98\% \end{aligned}$$

Model Graph :

A graph is drawn between length of the pendulum and square of the time period ,
the nature of the graph is a straight line passing through origin



Precautions :

The pendulum should oscillate with small amplitudes

The pendulum should oscillate in the vertical plane

Spinning oscillations are not considered

Result :

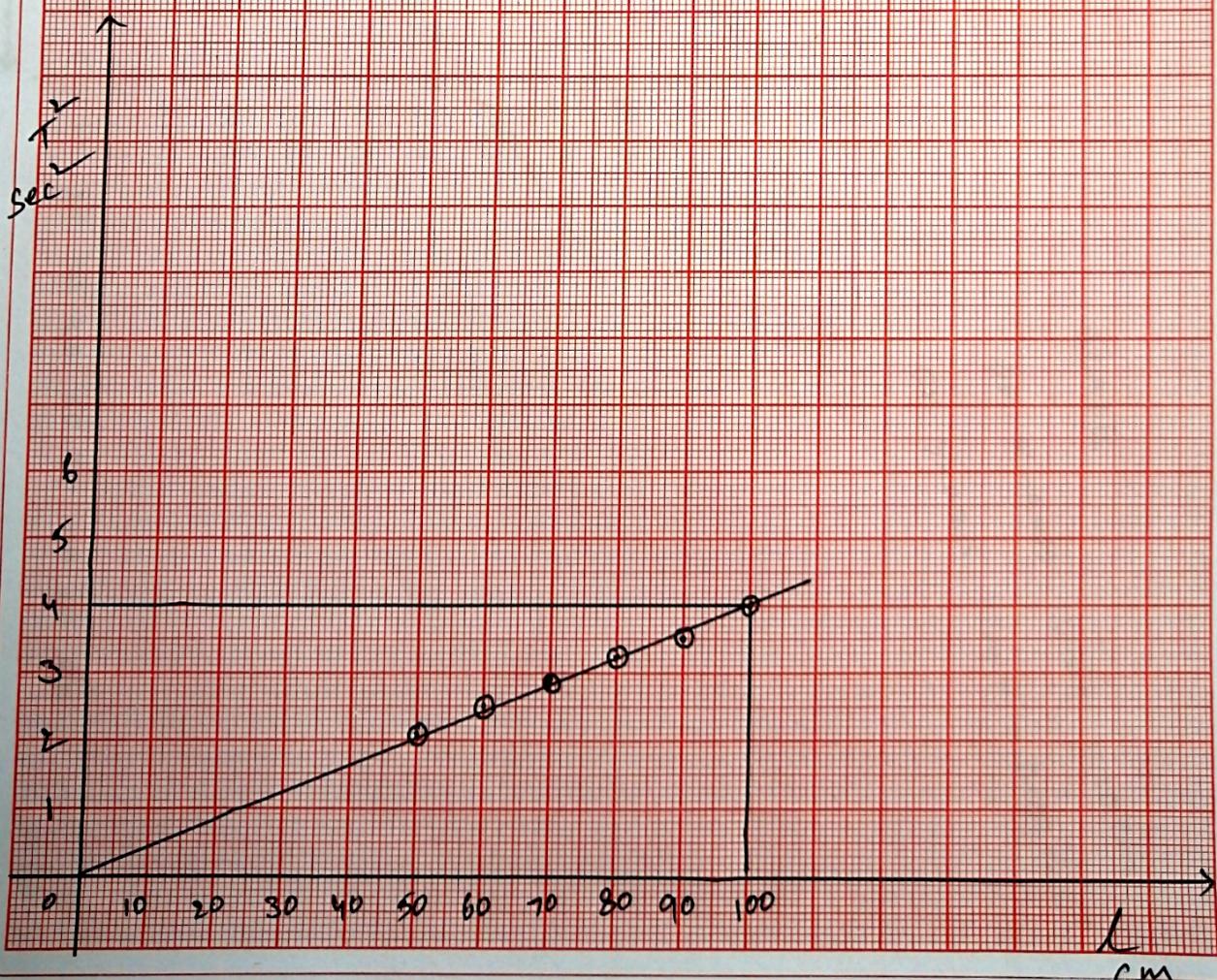
Acceleration due to gravity $g = 970.3 \text{ cm/s}^2$

Percentage error in determine the value of $g = 0.98 \%$

Length of seconds pendulum from $L - T^2$ graph = 100 cm

SCALE

on X-axis 1 unit = 10 cm

on Y-axis 1 unit = 1 sec⁻²

FORMULA :

To verify parallelogram law $OC = OD$ cm

$$\text{To verify Triangle law } \frac{P}{p} = \frac{Q}{q} = \frac{R}{r}$$

Volume of the given stone $V = W_1 - W_2$ c.c

$$\text{Relative density of the stone } d = \frac{W_1}{W_1 - W_2}$$

Where

W_1 - weight of the stone in air gm

W_2 - weight of the stone in water gm

Table 1 : To verify parallelogram law

Sl no	P gm wt	Q gm wt	R gm wt	OA cm	OB cm	OC cm	OD cm	<u>COD</u>
1	100	100	100	2	2	2	2	180
2	150	150	150	3	3	3	3	180

Table 2 : To verify Triangle law

Sl no	P gm wt	Q gm wt	R gm wt	p cm	q cm	r cm	$\frac{P}{p}$	$\frac{Q}{q}$	$\frac{R}{r}$
1	100	100	100	3	3	3	33.3	33.3	33.3
2	150	150	150	3	3	3	50	50	50

Table 3: To determine the weight of stone using parallelogram law

Sl no	P gm wt	Q gm wt	R gm wt	OA cm	OB cm	OC cm	Weight of the stone $W = OC \times \text{Scale gm}$
1	150	150	W_1	3	3	3	150
2	100	100	W_2	2	2	1.5	75

Average weight of the stone in air $W_1 = 150$ gm

Average weight of the stone in water $W_2 = 75$ gm

Table 4: To determine the weight of stone using Triangle law

Sl no	P gm wt	Q gm wt	R gm wt	p cm	q cm	r cm	Weight of the stone $W = \frac{P}{p} r \text{ gm}$
1	150	150	W_1	3	3	3	150
2	100	100	W_2	4	4	2.8	70

Average weight of the stone in air $W_1 = 150$ gm

Average weight of the stone in water $W_2 = 70$ gm

Calculation :

Average weight of the stone in air $W_1 = 150$ gm

Average weight of the stone in water $W_2 = 72.5$ gm

Volume $V = W_1 - W_2 = 77.5$ cc

$$\text{Relative density } d = \frac{W_1}{W_1 - W_2} = \frac{150}{77.5} = 1.9354$$

Precautions :

Pulley should be frictional less

Weights should not touch the board

Result :

Triangle law and Parallelogram laws are verified

Volume of the given stone $V = 77.5$ cc

Relative density of the stone $d = 1.9354$

FORMULA :

$$\text{Force constant of the given spring is } K = \frac{4\pi^2 (m_2 - m_1)}{T_2^2 - T_1^2} \text{ dyne / cm}$$

Where T_1^2 - square of the time period when mass with m_1 in s^2

T_2^2 - square of the time period when mass with m_2 in s^2

Table :

Sl no	Load m gm	Time taken for 20 oscillations				Time Period $T = \frac{X}{20} s$	T^2 S ²
		Trail 1	Trail 2	Trail 3	Mean X sec		
1	200	13.5	14	14	13.84	0.692	0.4788
2	250	15	15	15	15	0.75	0.5625
3	300	16	16	16	16	0.8	0.6400

CALCULATION :

$$\begin{aligned} m_1 &= 200 \text{ gm} \quad m_2 = 250 \text{ gm} \\ K &= \frac{4\pi^2 (m_2 - m_1)}{T_2^2 - T_1^2} \\ &= \frac{4 \times 3.14^2 (250 - 200)}{0.5625^2 - 0.4788^2} \\ &= 23,600 \text{ dyne / cm} \end{aligned}$$

$$\begin{aligned} m_1 &= 250 \text{ gm} \quad m_2 = 300 \text{ gm} \\ K &= \frac{4\pi^2 (m_2 - m_1)}{T_2^2 - T_1^2} \\ &= \frac{4 \times 3.14^2 (300 - 250)}{0.64^2 - 0.5625^2} \\ &= 25,470 \text{ dyne / cm} \end{aligned}$$

$$\begin{aligned} m_1 &= 200 \text{ gm} \quad m_2 = 300 \text{ gm} \\ K &= \frac{4\pi^2 (m_2 - m_1)}{T_2^2 - T_1^2} \\ &= \frac{4 \times 3.14^2 (300 - 200)}{0.64^2 - 0.4788^2} \\ &= 24,500 \text{ dyne / cm} \end{aligned}$$

PRECAUTIONS :

Load should not be beyond elastic limit

Spring should be hanged to rigid support only.

Result : Force constant of given spring is $K = 24,520$ dyne/cm
 $= 24.520$ N/m

SURFACE TENSION OF A LIQUID

FORMULA:

EXP 7 / S2

$$\text{Surface tension of given liquid } T = \frac{\left(h + \frac{r}{3}\right)rdg}{2} \text{ dyne/cm}$$

Where h = capillary raise of liquid = 6.020 cm

r = radius of bore = 0.023 cm

d = density of liquid = 1 gm/cc

g = acceleration due to gravity = 980 cm/s²

$$\text{Least count of vernier} = \frac{\text{length of 1 div on main scale}}{\text{no of div on vernier scale}}$$

$$= \frac{1}{20} = 0.001 \text{ cm}$$

TABLE :

To determine the capillary raise of liquid:

Sl No.	Reading at lower meniscus (M.S.R)+(V.C x L.C)	R ₁ cm	Reading at the tip of the wire (M.S.R)+(V.C x L.C)	R ₂ cm	Capillary raise h = R ₁ - R ₂ cm
1	9.4 + (46 x 0.001) 9.4 + 0.046 9.446		3.4 + (26 x 0.001) 3.4 + 0.026 3.426		6.020

TABLE :

Sl No.	Position of the cross wire	Microscope readings (M.S.R)+(V.C x L.C) cm	Diameter of the bore d = R ₃ ~ R ₄ cm	Radius of the bore r = d/2 cm
1		4.90 + (12 x 0.001) 4.9 + 0.012 4.912		
2		4.95 + (8 x 0.001) 4.95 + 0.008 4.958	0.046	0.023

CALCULATION:

$$\text{Surface tension of given liquid } T = \frac{\left(h + \frac{r}{3}\right)rdg}{2} \text{ dyne/cm} = \frac{\left(6.020 + \frac{0.023}{3}\right)0.023 \times 1 \times 980}{2} = \frac{(6.020 + 0.0076)22.54}{2} = 67.9 \text{ dyne/cm}$$

PRECAUTIONS:-

- Capillary tube should be uniform bore.
- Capillary tube must be clamped vertically.

RESULT: Surface tension of given liquid $T = 67.9$ dyne/cm

APPARENT EXPANSION

FORMULA:

EXP 8/ S2

$$\text{Coefficient of apparent expansion } \gamma_a = \frac{m_2 - m_3}{(m_3 - m_1)(t_2 - t_1)} / {}^\circ\text{C}$$

Where m_1 = mass of empty specific gravity bottle = 25.310 gm

m_2 = mass of specific gravity bottle + liquid = 51.710 gm

m_3 = mass of specific gravity bottle + remaining liquid = 51.040 gm

t_1 = initial temperature = 33 ${}^\circ\text{C}$

t_2 = final temperature = 96 ${}^\circ\text{C}$

TABLE :

Sl.no	Contents in pans		Turning points		Mean turning points		Resting point	Masss of the body
	Left	Right	Left	Right	Left	Right		
1	-----	-----	2	18	2	18	10 (Z.R.P)	-----
2	Empty sp gravity bottle	20.000 5.000 0.200 0.100 0.010 ----- 25.310	2 5 5 5 2	18 5 19 19	2 5 19	18 12	25.310 (m_1)	
3	Sp gravity bottle + liquid	50.000 1.000 0.500 0.200 0.010 ----- 51.710	2 2 2	15 15	2 15	8.5	51.710 (m_2)	
4	Sp gravity bottle + remaining liquid	50.000 1.000 0.020 0.020 ----- -- 51.040	1 1 1	19 19	1 19	10	51.040 (m_3)	

CALCULATION :

$$\begin{aligned} \text{Coefficient of apparent expansion } \gamma_a &= \frac{m_2 - m_3}{(m_3 - m_1)(t_2 - t_1)} / {}^\circ\text{C} \\ &= \frac{51.710 - 51.040}{(51.040 - 25.310)(96 - 33)} \\ &= \frac{0.67}{25.73 \times 63} = 0.000413 / {}^\circ\text{C} \end{aligned}$$

PRECAUTIONS :-

- Heavy weights should not be added.
- Expelled liquid should not fall into water bath.

RESULT : Coefficient of apparent expansion = 0.000413 / ${}^\circ\text{C}$

BOYLES LAW

FORMULA :

EXP 9 / S2

At constant temperature for a given mass of gas volume is directly proportional to pressure.
 $P V = \text{Constant}$

Since area of bore is constant, $p l = \text{constant}$

Pressure of the air column $p = H \pm h$

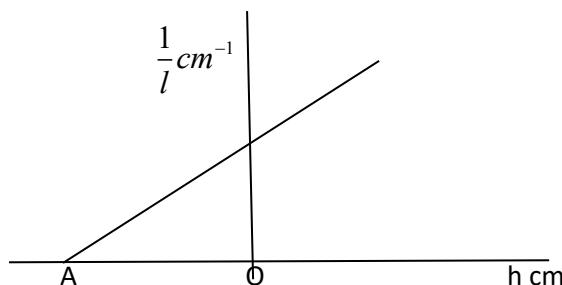
Where $H = \text{atmospheric pressure} = 76 \text{ cm of Hg}$
 $h = h_1 - h_2 \text{ cm}$

Table : To verify boyles law:

Sl.no	Position of the tube	Length of the air column $l \text{ cm}$	$\frac{1}{l} \text{ cm}^{-1}$	Vertical heights		Difference in heights $h = h_1 - h_2 \text{ cm}$	Pressure $p = H \pm h \text{ cm}$	$p l = \text{constant}$
				$h_1 \text{ cm}$	$h_2 \text{ cm}$			
1		16.1	0.0621	44.4	54.5	10.1	86.1	1386
2		16.5	0.0606	47	54.9	7.9	83.9	1384
3		18.2	0.0549	52.2	52.2	0	76	1383
4		19.8	0.0505	54.1	48.2	-5.9	70.1	1388
5		21.2	0.0471	54.2	44.2	-10	66	1399
6		20.2	0.0495	53	46.7	-6.3	69.7	1407

$h - 1/l$ graph :

a graph is drawn between h and $1/l$ taking h on X axis and $1/l$ on y axis.
The -ve X intercept gives the value of atmospheric pressure.



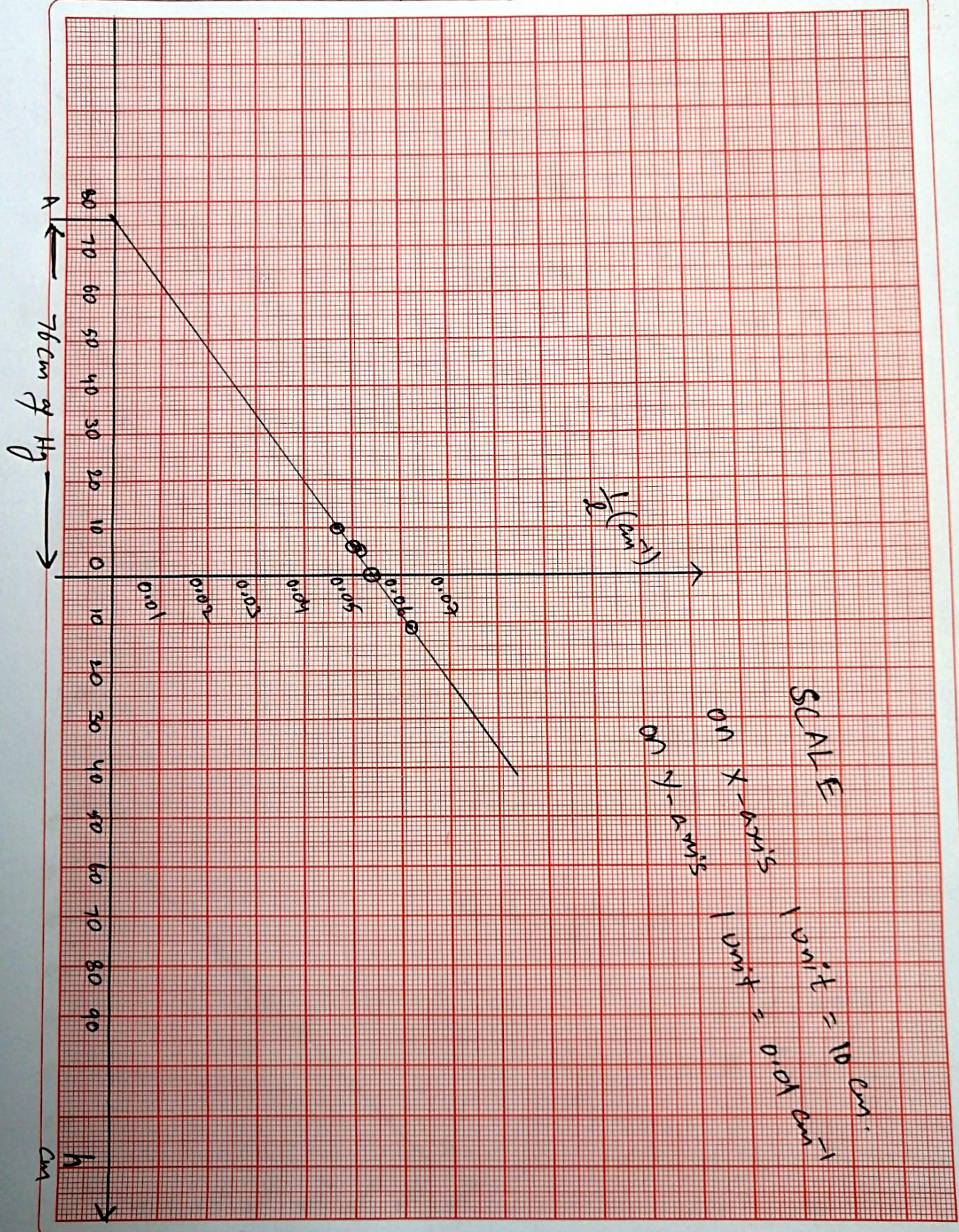
PRECAUTIONS :

- Temperature should be constant.
- Quill tube must have uniform bore.
- Quill tube must be fixed vertically.

Result : Boyles law is verified

Atmospheric pressure from $h - 1/l$ graph is 76 cm of Hg

BOYLE'S LAW



SPECIFIC HEAT OF A SOLID

FORMULA:

EXP 10 / S2

$$\text{Specific heat of given solid } s = \frac{[m_1 s_1 + (m_2 - m_1) s_2](t_3 - t_1)}{(m_3 - m_2)(t_2 - t_3)} \text{ cal / gm } ^\circ\text{C}$$

Where m_1 = mass of empty calorimeter + stirrer = 42.880 gm

m_2 = mass of calorimeter + stirrer + water = 126.375 gm

m_3 = mass of calorimeter + stirrer + water + solid = 140.975 gm

t_1 = initial temperature = 33 $^\circ\text{C}$ t_2 = temperature of solid = 98 $^\circ\text{C}$

t_3 = resultant temperature = 35 $^\circ\text{C}$ s_1 = Specific heat of calorimeter = 0.092 cal / gm $^\circ\text{C}$

s_2 = Specific heat of water = 1 cal / gm $^\circ\text{C}$

Sl.no	Contents in pans		Turning points		Mean turning points		Resting point	Mass of the body
	Left	Right	Left	Right	Left	Right		
1	_____	_____	3 3 17 17	17 17	3 3	17 17	10 (ZRP)	-----
2	mass of empty calorimeter + stirrer	20.000 20.000 2.000 0.500 0.050 0.020 0.0210 42.880	2 2 16 16 2	16 16	2 2	16 16	9	42.880 (m_1)
3	mass of calorimeter + stirrer + water	100.000 20.000 10.000 5.000 1.000 0.200 0.100 0.050 0.020 0.005 126.375	1 1 18 18 1	18 18	1 1	18 18	9.5	126.375 (m_2)
4	mass of calorimeter + stirrer + water + solid	100.000 20.000 20.000 0.500 0.050 0.020 0.005 140.975	2 2 18 18 2	18 18	2 2	18 18	10	140.975 (m_3)

TABLE :

CALCULATION:

$$\begin{aligned} \text{Specific heat of given solid } s &= \frac{[m_1 s_1 + (m_2 - m_1) s_2](t_3 - t_1)}{(m_3 - m_2)(t_2 - t_3)} \text{ cal / gm } ^\circ\text{C} \\ &= \frac{[42.880 \times 0.092 + (126.375 - 42.880)1](35 - 33)}{(140.975 - 126.375)(98 - 35)} = \frac{(3.994 + 83.495)2}{14.6 \times 63} \\ &= 0.1900 \text{ cal / gm } ^\circ\text{C} \end{aligned}$$

PRECAUTIONS :-

Calorimeter should be highly polished.
Solid pieces should be small.

RESULT: Specific heat of given solid = 0.1900 cal / gm $^\circ\text{C}$

VELOCITY OF SOUND

Formula :-

Exp:- 11/s2

$$\text{Velocity of sound at room temperature } V_t = 2n(l_2 - l_1) \text{ cm/s}$$

Where n = frequency of tuning fork in Hz

l_1 = first resonating length in cm

l_2 = second resonating length in cm

$$\text{Velocity of sound at } 0^\circ\text{C} \quad V_0 = V_t \left(1 - \frac{t}{546}\right) \text{ cm/s}$$

Where t = room temperature in ${}^0\text{C}$ = 28°C

$$\text{Compare the frequencies of two forks} \quad \frac{n_1}{n_2} = \frac{l_2^! - l_1^!}{l_2 - l_1}$$

Table :- To determine the velocity of sound at room temperature

Sl.no	Frequency of the tuning fork n Hz	Length of resonating air column						$l_2 - l_1$	Velocity of sound at room temperature $V_t = 2n(l_2 - l_1) \text{ cm/s}$		
		1 st resonating length			2 nd resonating length						
		Trail 1	Trail 2	Mean l_1 cm	Trail 1	Trail 2	Mean l_2 cm				
1	512	16.1	16.1	16.1	50	50.2	50.1	34.0	34816		
2	480	17.1	17.3	17.2	52.8	52.8	52.8	35.6	34176		
3	426	20.1	20.1	20.1	61.5	61.5	61.5	41.1	35272		
4	n	20.2	20.2	20.2	62	62	62	41.8	--		

0

Average value of V_t = 34754 cm/s

Calculations :

$$\text{Velocity of sound at } 0^\circ\text{C} \quad V_0 = V_t \left(1 - \frac{t}{546}\right) = 34754 \left(1 - \frac{28}{546}\right) = 32971 \text{ cm/s}$$

$$\text{Compare the frequencies of two forks} \quad \frac{n_1}{n_2} = \frac{l_2^! - l_1^!}{l_2 - l_1} = \frac{35.6}{34} = 1.047$$

Precautions :-

1. The reading of water level must be taken without any parallax error
2. The fork must be excited by hitting the prongs with a rubber hammer
3. The fork must be held horizontal so that the prongs vibrate in vertical plane.

Result:-

Velocity of sound at room temperature $V_t = 34754$ cm/s

Velocity of sound at 0°C is $V_0 = 32971$ cm/s

CONCAVE MIRROR

EXP 12/S2

FORMULA :

$$\text{Focal length of concave mirror } f = \frac{uv}{u+v} \text{ cm}$$

Where u - object distance in cm

V - Image distance in cm

Focal length of mirror from infinite distance method $f = 20 \text{ cm}$

Table :

Sl no	Object distance U cm	Image distance V cm	$\frac{1}{u} \text{ cm}^{-1}$	$\frac{1}{v} \text{ cm}^{-1}$	$f = \frac{uv}{u+v} \text{ cm}$
1	30	60	0.033	0.016	20
2	35	46.5	0.028	0.021	19.96
3	40	40	0.025	0.025	20
4	45	36	0.022	0.027	20
5	50	33.3	0.020	0.030	19.98
6	55	31.4	0.018	0.032	19.98

Average focal length of the mirror $f = 19.98 \text{ cm}$

Precautions :

Principle axis of the mirror should be horizontal

The upright s should be vertical

Readings should be taken without parallax error.

Result:

Focal length of the mirror from infinite object distance method $f = 20 \text{ cm}$

Focal length of mirror from $f = 19.98 \text{ cm}$

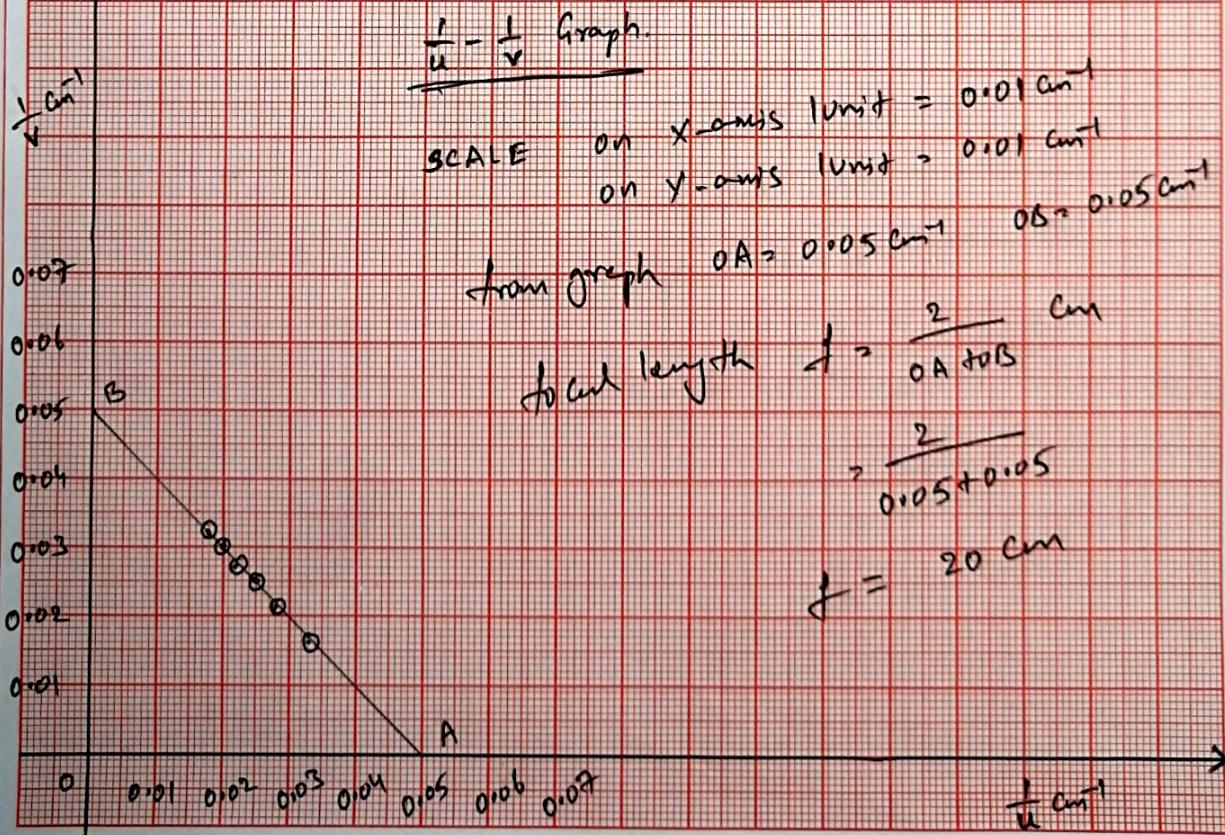
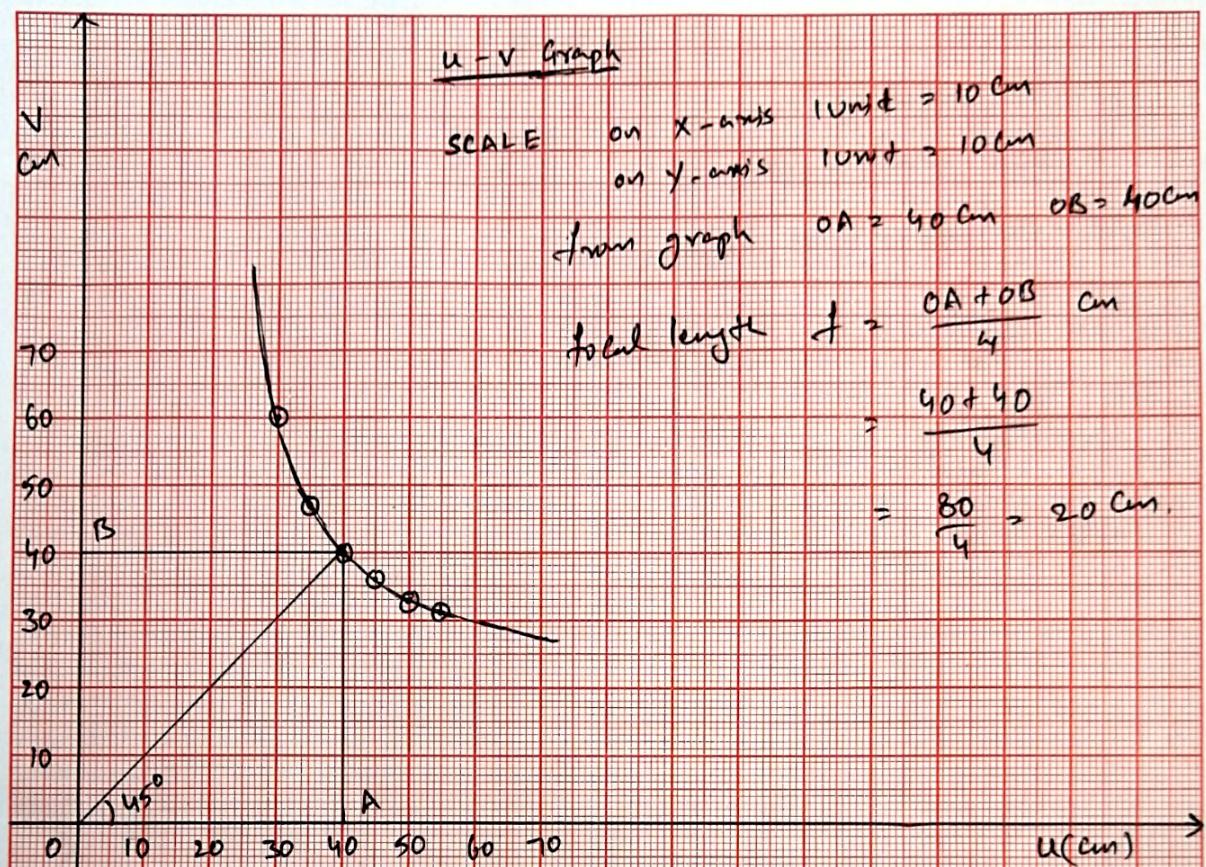
Focal length from $u-v$ graph $f = 20 \text{ cm}$

Focal length from $\frac{1}{u} - \frac{1}{v}$ graph $f = 20 \text{ cm}$

CONCAVE MIRROR

Set - II

Page No.



FORMULA:

$$\text{Focal length of convex lens from } u-v \text{ method } f = \frac{uv}{u+v} \text{ cm}$$

Where u - object distance in cm
 v - Image distance in cm

$$\text{Focal length of convex lens from lens displacement method } f = \frac{l^2 - d^2}{4l} \text{ cm}$$

Where l - distance between object and screen in cm
 d - difference between position of lens in cm
Focal length of lens from infinite distance method $f = 20$ cm

Table 1:

Sl no	Object distance U cm	Image distance V cm	$\frac{1}{u}$ cm ⁻¹	$\frac{1}{v}$ cm ⁻¹	$f = \frac{uv}{u+v}$ cm
1	30	45	0.033	0.022	18
2	35	37	0.028	0.027	17.98
3	40	33	0.025	0.030	18.1
4	45	30	0.022	0.033	18
5	50	28	0.020	0.035	17.95
6	55	26.5	0.018	0.037	17.89

Average focal length of the lens $f = 17.98$ cm

Table 2:

Sl no	Distance between Object and screen l cm	Position of convex lens		Difference between the positions $d = d_1 - d_2$ cm	$f = \frac{l^2 - d^2}{4l}$ cm
		1 st position of lens d_1 cm	2 nd position of lens d_2 cm		
1	76	30	47.5	17.5	17.99
2	78	29	50.5	21.5	17.81
3	80	28	53.3	25.3	17.99
4	82	27	55.7	28.7	17.99
5	84	26.5	58.3	31.8	17.99
6	86	26	60.7	34.7	18.53

Average focal length of the lens from lens displacement method $f = 18.05$ cm

Precautions :

- Principle axis of the lens should be horizontal
- The upright s should be vertical
- Readings should be taken without parallax error

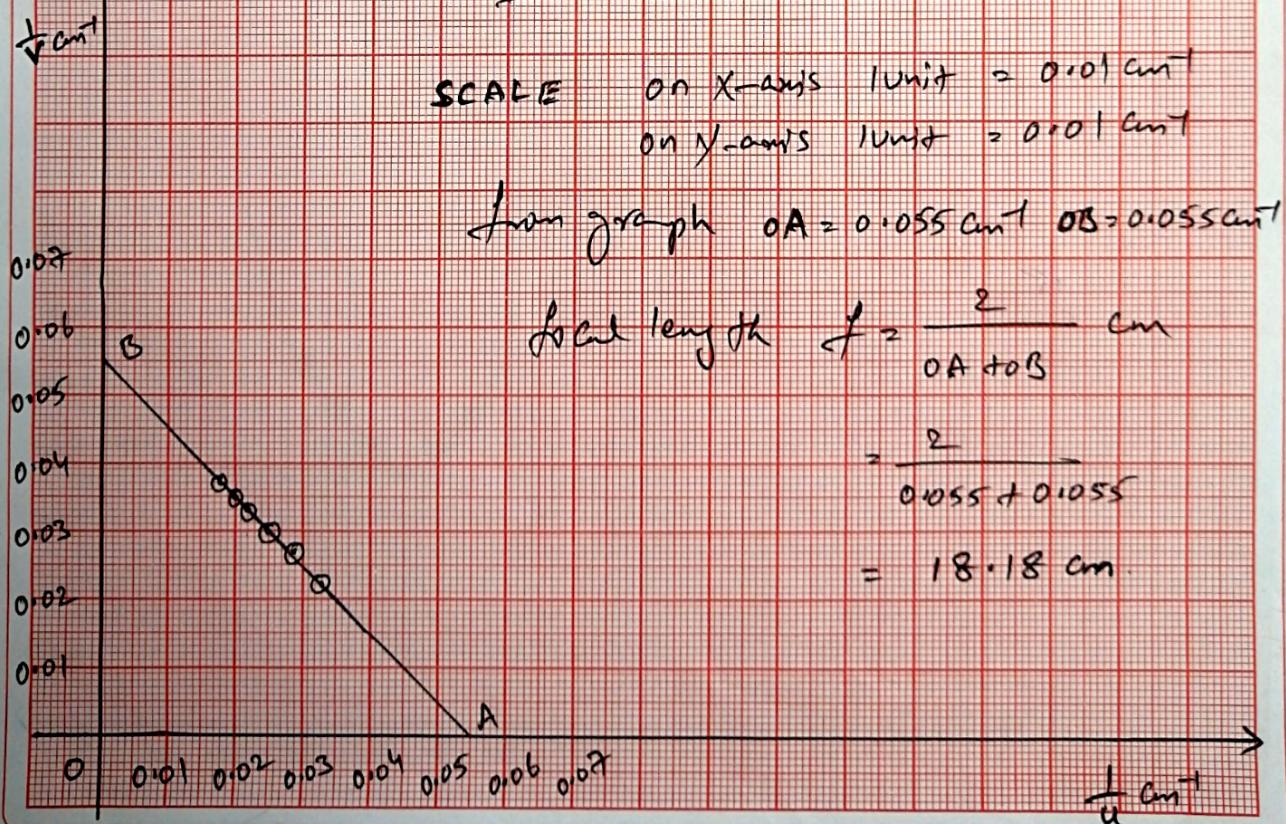
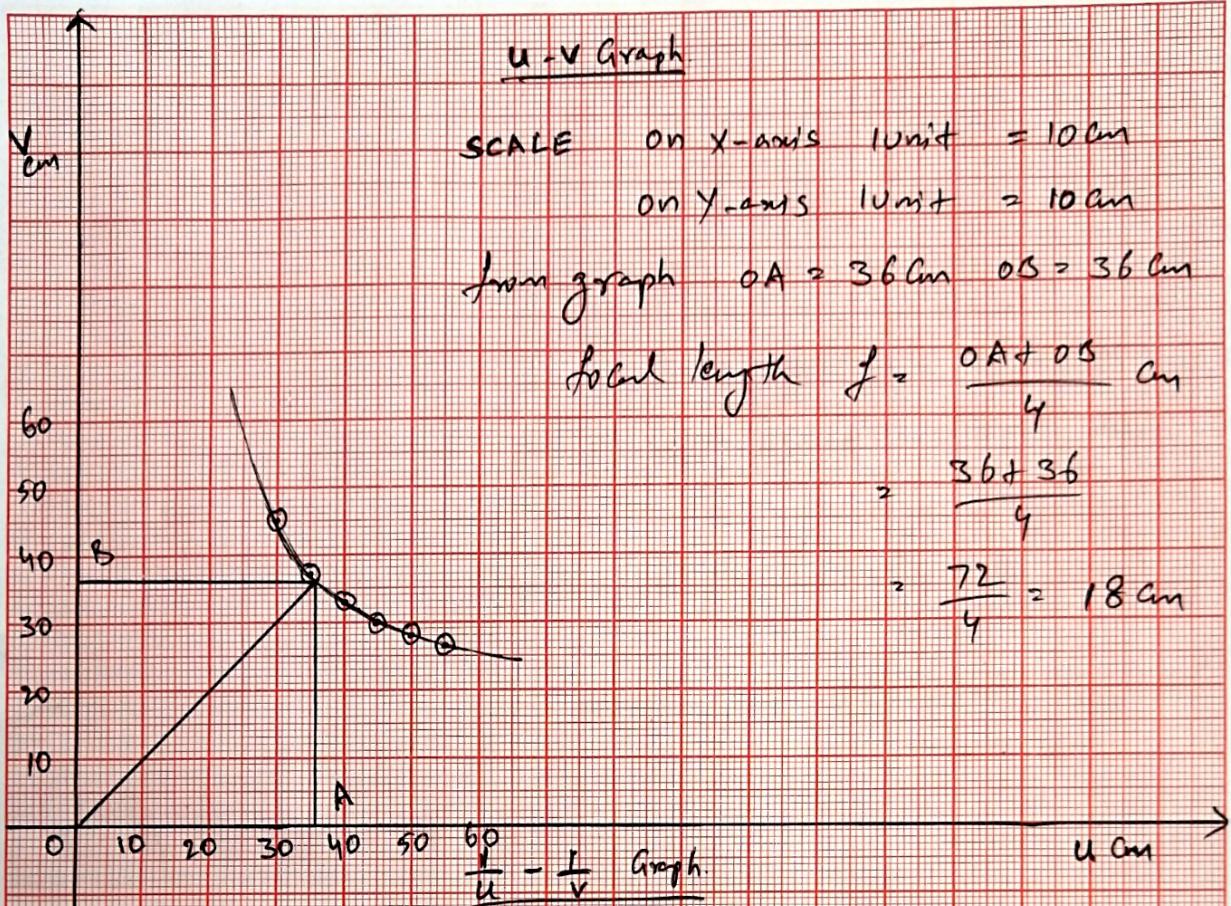
Result : Focal length of lens from infinite distance method $f = 20$ cm

Focal length of the lens from $u-v$ method $f = 17.98$ cm

Focal length of the lens from lens displacement method $f = 18.05$ cm

Focal length from $u-v$ graph $f = 18$ cm

Focal length from $\frac{1}{u} - \frac{1}{v}$ graph $f = 18.18$ cm



PRISM

EXP 15 / S2

Formula :-

$$\text{Refractive index of the prism } \mu = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

Angle of the prism

$$A = 2 \tan^{-1} \left(\frac{\sin\left(\frac{D_m}{2}\right)}{\mu - \cos\left(\frac{D_m}{2}\right)} \right)$$

Where A – angle of the prism in degree

D_m – angle of minimum deviation in degree

Table :- To determine the angle of minimum deviation

Sl.No	Angle of incidence i in degree	Angle of deviation d in degree
1	30	44
2	35	40
3	40	37
4	45	39
5	50	42
6	55	46

Angle of minimum deviation D_m is = 37^0

$$\text{Refractive index of the prism } \mu = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} \Rightarrow \mu = \frac{\sin\left(\frac{60+37}{2}\right)}{\sin\left(\frac{60}{2}\right)} = \frac{\sin 48.5}{\sin 30} = 1.497$$

Angle of the prism

$$A = 2 \tan^{-1} \left(\frac{\sin\left(\frac{D_m}{2}\right)}{\mu - \cos\left(\frac{D_m}{2}\right)} \right) \Rightarrow A = 2 \tan^{-1} \left(\frac{\sin\left(\frac{37}{2}\right)}{1.497 - \cos\left(\frac{37}{2}\right)} \right) = 2 \tan^{-1} \left(\frac{\sin 18.5}{1.497 - \cos 18.5} \right)$$

$$A = 59.8^0$$

Precautions :

- Prism must be fixed vertically
- Same prism must be used for all observations and it should not be disturbed during the experiment

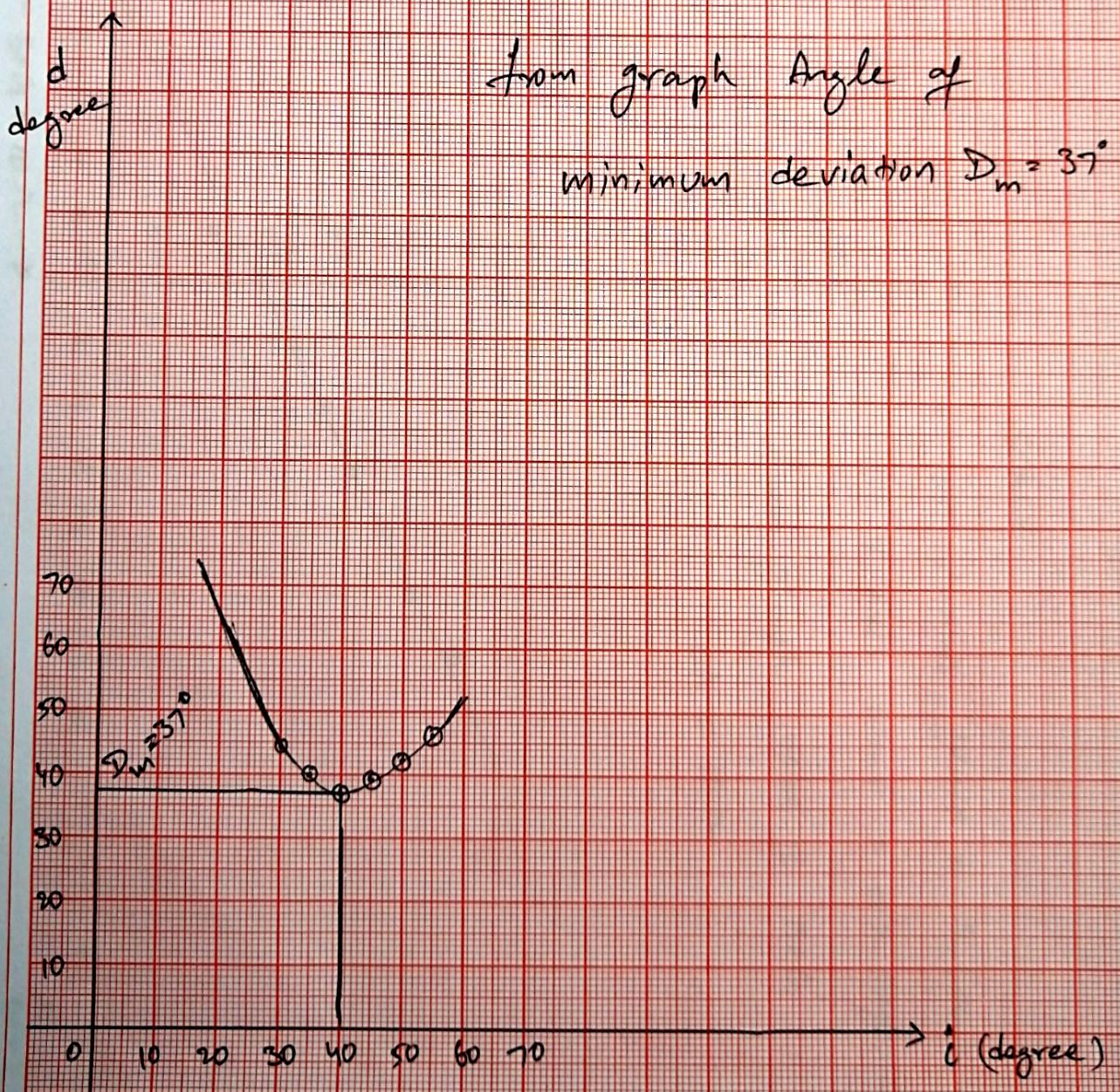
Result :-

- Refractive index of the prism = 1.497
- Angle of the prism = 59.8^0
- Angle of minimum deviation from graph = 37^0

SCALE

on x-axis 1 unit = 10 degree

on y-axis 1 unit = 10 degree



TANGENT GALVANOMETER

Formula :-

Exp : 16/S2

Strength of electric current flowing in the circuit $i = k \tan \theta$ A

$$\text{Where } k \text{ is reduction factor } k = \frac{10rH}{2\pi n}$$

r = radius of the coil = $\frac{49.5}{2\pi} = 7.87$ cm

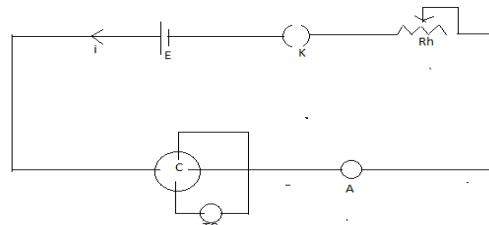
H = horizontal component of earth's magnetic field = 0.38 Oersted

n = number of turns = 2

θ = Average deflection of T.G in degree

Table Determine the strength of electric current in the circuit

S.No	Ammeter reading i A	Deflections in T.G				Mean θ degree	Tan θ	$i = k \tan \theta$
		θ_1	θ_2	θ_3	θ_4			
1	1.6	30	30	38	38	34	0.674	1.604
2	2.0	36	36	44	44	40	0.839	1.997
3	2.4	41	41	49	49	45	1	2.38
4	2.8	46	46	51	51	48.5	1.13	2.68
5	3.2	48	48	54	54	51	1.234	2.938
6	3.4	50	50	60	60	55	1.428	3.4



$$k = \frac{10rH}{2\pi n} = \frac{10 \times 7.87 \times 0.38}{2 \times 3.14 \times 2} = 2.381$$

Precautions :-

1 The compass is gently tapped on the glass top and then the deflections are noted

2 After adjusting the TG it should not be disturbed throughout the experiment

3 The deflections must be taken between 30° to 60°

Result :-

Strength of electric current is calculated and verified using ammeter

Reduction factor of TG $k = 2.381$ A

OHMS LAW

Formula :-

Exp: 17/s2

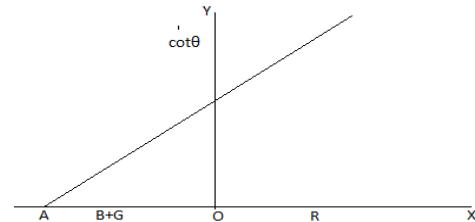
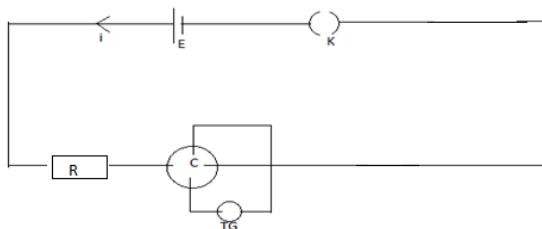
To verify the Ohms law ($R+B+G$) $\tan \theta = \text{constant}$

Where R = resistance in resistance box in Ω

B = resistance of battery in Ω

G = resistance of tangent galvanometer in Ω

θ = Average deflection in TG in degree



From graph value of $(B+G) = \underline{11} \Omega$

Table : verification of ohms law

S.No	Resistance in resistance box $R \Omega$	Deflections in T G degree				Mean θ	$\tan \theta$	$\cot \theta$	$(R+B+G)\tan \theta = \text{const}$
		θ_1	θ_2	θ_3	θ_4				
1	5	50	50	49	49	49.5	1.17	0.854	18.72
2	6	48	48	48	48	48	1.11	0.897	18.87
3	7	46	46	45	45	45.5	1.017	0.982	18.30
4	8	45	45	45	45	45	1	1	19
5	9	43	43	44	44	43.5	0.95	1.053	19
6	10	42	42	42	42	42	0.90	1.11	18.9

Precautions :-

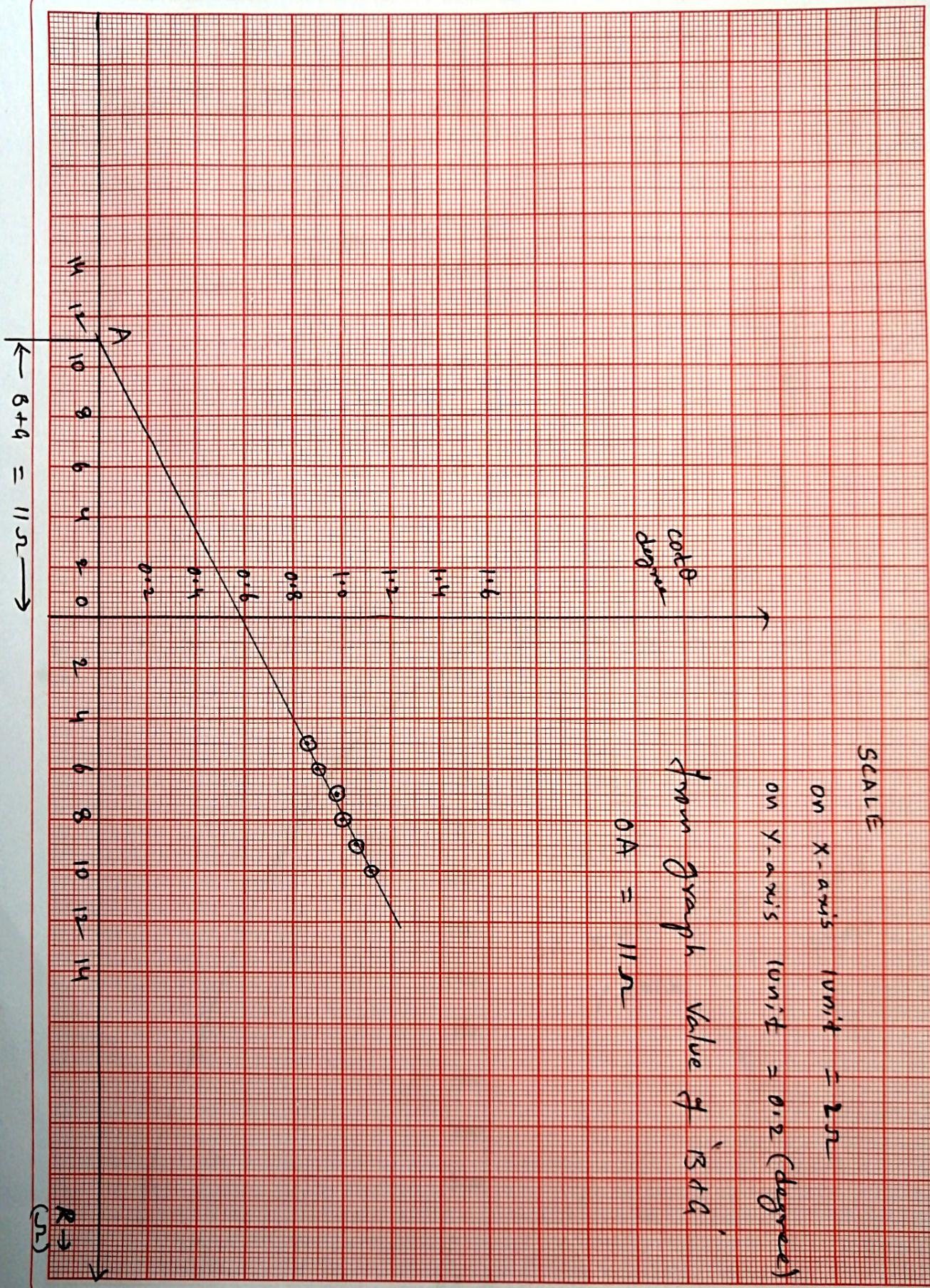
1. The TG must not be disturbed during the experiment
2. Select the resistance so that the deflections are between 30° to 60°
3. the magnetic materials must be kept away from the TG

Result :-

Ohms law is verified

Value of $(B+G)$ from $R\text{-}\cot \theta$ graph is $\underline{11} \Omega$

OHM'S LAW Set -II Page No.



METER BRIDGE

EXP 18/S2

$$\text{Formula :- Resistance of the given wire } x = R \left(\frac{l_1}{l_2} \right) \Omega \quad \text{Specific resistance of the wire } \rho = x \frac{\pi r^2}{l} \Omega \text{ cm}$$

X - resistance of the unknown wire Ω

X – resistance of the given wire Ω

R – Resistance in the right gap Ω

l_1 - Balancing length from left in cm

r – radius of the wire in cm

l_2 - Balancing length from right in cm

l – length of the wire in cm

$$\text{Individual resistance of 1}^{\text{st}} \text{ wire} \quad R_1 = \frac{R_s + \sqrt{R_s^2 - 4R_s R_p}}{2} \Omega$$

$$2^{\text{nd}} \text{ wire} \quad R_2 = \frac{R_s - \sqrt{R_s^2 - 4R_s R_p}}{2} \Omega$$

Where R_s – effective resistance when R_1, R_2 are connected in series in Ω

R_p – effective resistance when R_1, R_2 are connected in parallel in Ω

$$\text{pitch of the screw} = \frac{\text{Distance moved on pitch scale}}{\text{No. of rotations}} = \frac{5\text{mm}}{5} = 1\text{mm}$$

$$\text{Least count} = \frac{\text{Pitch of the screw}}{\text{No. of divisions on head scale}} = \frac{1\text{mm}}{100} = 0.01\text{mm}$$

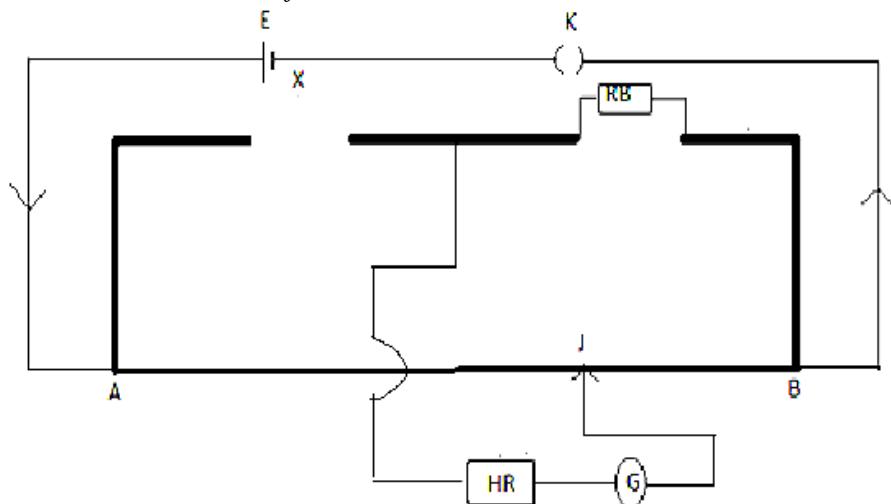


Table 1 To determine the radius of given wire

Error : -1 Correction : +1

Sl No	Pitch scale reading a mm	Head scale reading		Fraction b = n X L.C mm	Total a+b mm
		Observed	Correction n		
1	1	2	3	0.03	1.03
2	1	2	3	0.03	1.03
3	1	3	4	0.04	1.04

Average diameter of the wire $d = 1.033 \text{ mm} = 0.1033 \text{ cm}$

Radius of the wire $r = 0.05165 \text{ cm}$

Table 2 : Determination of resistance of the wire

Sl.no	Resistance in the gaps		Balancing lengths		Resistance of the wire $x = R \left(\frac{l_1}{l_2} \right) \Omega$
	Left X Ω	Right R Ω	From left l_1 cm	From right l_2 cm	
1	X	2	67.3	32.7	4.116
2	X	4	50.5	49.5	4.08
3	X	6	40.4	59.6	4.067

Average resistance of the wire $x=4.087 \Omega$

$$\text{Specific resistance } \rho = x \frac{\pi r^2}{l} \Omega \text{ cm} = 4.087 \times 3.141x(0.05165)^2 \\ = 0.000428 \Omega \text{ cm.}$$

Table 3 Determination of individual resistances of each wire

Sl.no	Combination of wires	Resistances in gaps		Balancing lengths		Resistance of combination $= R \frac{l_1}{l_2} \Omega$
		Left X Ω	Right R Ω	Left l_1 cm	Right l_2 cm	
1	Series	X	8	55.8	44.2	10.09
2		X	10	50.2	49.8	10.08
3		X	12	48	52	11.07
4	Parallel	X	2	55	45	2.44
5		X	4	40	60	2.66
6		X	6	29	71	2.45

Average resistance in series combination $R_s = 10.41 \Omega$

Average resistance in parallel combination $R_p = 2.516 \Omega$

$$\text{Resistance of 1}^{\text{st}} \text{ wire } R_1 = \frac{R_s + \sqrt{R_s^2 - 4R_s R_p}}{2} \Omega \\ = \frac{10.41 + \sqrt{10.41^2 - 4 \times 10.41 \times 2.516}}{2} \\ = 6.645 \Omega$$

$$\text{Resistance of 2}^{\text{nd}} \text{ wire } R_2 = \frac{R_s - \sqrt{R_s^2 - 4R_s R_p}}{2} \Omega \\ = \frac{10.41 - \sqrt{10.41^2 - 4 \times 10.41 \times 2.516}}{2} \\ = 3.765 \Omega$$

Precautions :- 1 . Jockey should not be dragged

2. Only small currents must be passed through the wire
3. The resistance in the gaps are to be nearly equal

Result :- Resistance of the given wire $X = 4.087 \Omega$

Specific Resistance of the given wire $s = 0.000428 \Omega \text{ cm}$

Individual resistances of two wires $R_1 = 6.645 \Omega$

$R_2 = 3.765 \Omega$

JUNCTION DIODE

CIRCUITS :-

EXP 19/S2

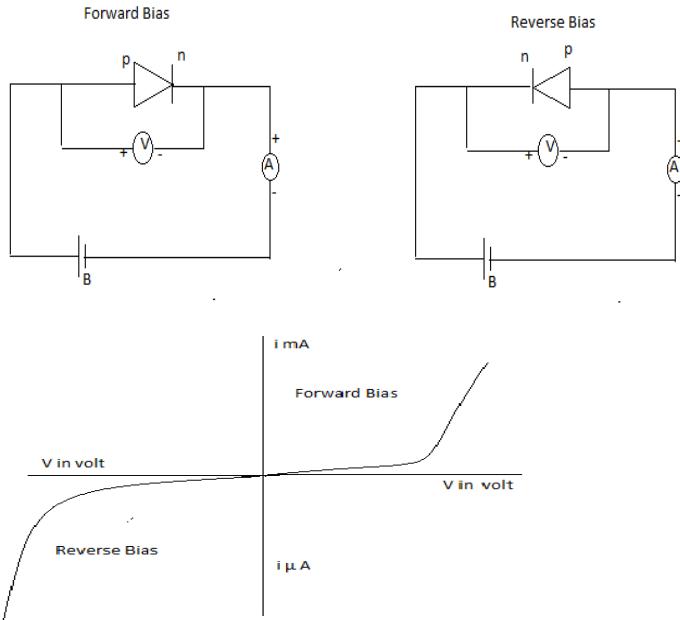


TABLE: Forward Bias

S.No	Voltage across diode V volt	Current through diode i m A
1	0	0
2	0.1	0
3	0.2	0
4	0.3	0
5	0.4	0
6	0.5	0.4
7	0.6	1.3
8	0.62	2.4
9	0.64	3.6

Reverse Bias

S.No	Voltage across diode V volt	Current through diode i μA
1	0	0
2	5	18
3	10	32
4	15	56
5	20	86
6	25	128
7	30	176
8	35	230

Precautions :-

1. Diode should not be connected directly to the battery without resistance
2. In reverse bias care must be taken so that the reverse bias voltage is well below the break down voltage

Result :-

V- i Characteristics are drawn by using junction diode

JUNCTION DIODE

Set - II Page No.

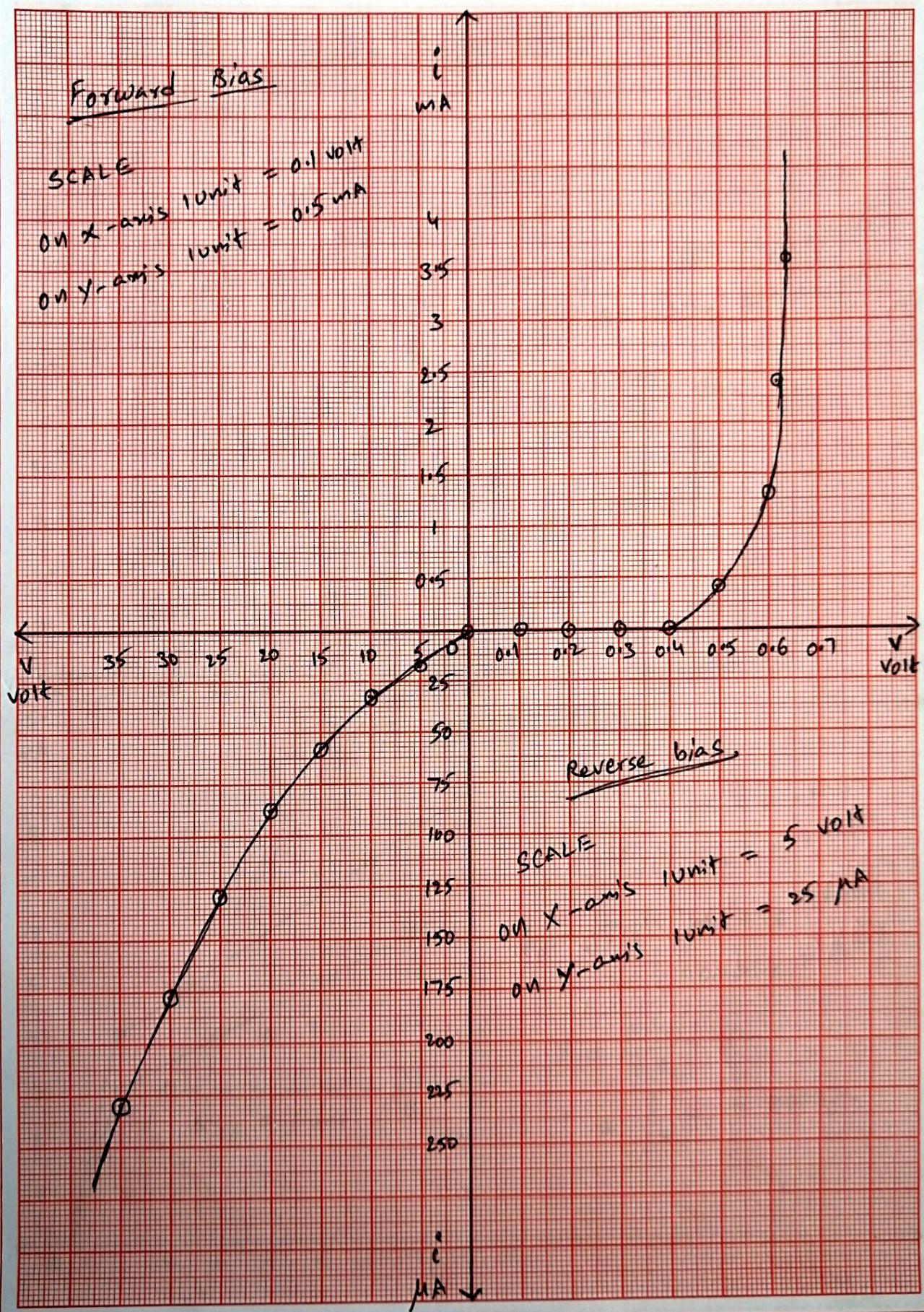


Table 1: INPUT CHARACTERSTICS :

Slno	Voltage across base and emitter V_{BE} volt	Current through Base I_B μA	
		$V_{CE} = 0V$	$V_{CE} = 1V$
1	0	0	0
2	0.5	0	0
3	0.6	50	15
4	0.62	55	20
5	0.64	70	25
6	0.66	80	35
7	0.68	95	45
8	0.70	110	55
9	0.72	120	70

Table 2: OUTPUT CHARACTERSTICS :

Sl.No	Voltage across Collector and emitter V_{CE} volt	Current through collector I_c mA	
		$I_B = 100 \mu A$	$I_B = 150 \mu A$
1	0	0	0
2	1	17	27
3	2	18	28
4	3	18	29
5	4	19	29
6	5	19	30
7	6	20	31
8	7	21	32

Table 3 : TRANSFER CHARACTERSTICS: $V_{CE} = 1V$

Sl no	I_B μA	I_c mA
1	0	0
2	10	1.5
3	20	3
4	30	4
5	40	5.5
6	50	7
7	60	8.5

Result: Input and Output characteristics of a P-N-P /N-P-N transistor are drawn

Input resistance $1.764 \text{ k}\Omega$

Output resistance $1.714 \text{ k}\Omega$

Current gain $\beta = 140$

TRANSISTOR CHARACTERISTICS

Set - II Page No.

