FORMULA :

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

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

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

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	6	0.06	1.86
2	1.8	7	0.07	1.87
3	1.8	6	0.06	1.86
4	1.8	8	0.08	1.88
5	1.8	7	0.07	1.87
6	1.8	6	0.06	1.86

Diameter of the sphere d = 1.866 cm
Radius of the sphere r = 0.933 cm

Calculation :

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

$$= \frac{4}{3} X \ 3.14 \ X \left(0.933\right)^3$$

$$= 3.401 cm^3$$

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 = 3.041 cm^3

FORMULA :

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

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

Error : + 4 Correction : - 4

Table 1 : To determine the radius of given cylinder

Sl No	Pitch scale Reading a mm	Head scale reading		Fraction b = n x LC	Total a + b mm
		Observed	Correction n		
1	2	56	52	0.52	2.52
2	2	55	51	0.51	2.51
3	2	55	51	0.51	2.51
4	2	56	52	0.52	2.52
5	2	55	51	0.51	2.51
6	2	55	51	0.51	2.51

Average diameter of the cylinder d = 2.513 mm

Radius of the cylinder r = 1.2565 mm

Table 2 : To determine the thickness of glass plate :

Sl No	Pitch scale Reading a mm	Head scale reading		Fraction b = n x LC	Total a + b mm
		Observed	Correction n		
1	1	27	23	0.23	1.23
2	1	28	24	0.24	1.24
3	1	27	23	0.23	1.23
4	1	26	22	0.22	1.22
5	1	27	23	0.23	1.23
6	1	28	24	0.24	1.24

Thickness of the glass plate t = 1.231 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 = 1.2565 mm
Thickness of the glass plate t = 1.231 mm

FORMULA :

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

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	--------	---------	3 3 3	17 17	3	17	10 (ZRP)
2	Iron bolt	10.000 2.000 0.500 0.200 0.100 0.020 ----------------- 12.820 gm	1 1 1	17 17	1	17	9 (LRP)
3	Iron bolt	10.000 2.000 0.500 0.200 0.100 0.010 ----------------- 12.810 gm	3 3 3	19 19	3	19	11 (HRP)

CALCULATIONS :

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

$$= 12.810 + \left[\frac{11 - 10}{11 - 9} \right] X\ 0.01$$

$$= 12.810 + 0.5(0.01)$$

$$= 12.810 + 0.005$$

$$= 12.815\ gm$$

$$Volume\ of\ the\ object\ V = \frac{mass}{density} = \frac{12.815}{7.87} = 1.628\ cm^3$$

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

Result : Mass of the given body 12.815 gm
Volume of the body 1.628 cm^3

FORMULA :

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

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

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

Where l – length of the pendulum cm
T – time period of the pendulum sec

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

Where g^l - 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	7	0.07	1.07
3	1.8	8	0.08	1.08

Diameter of the bob d = 1.873 cm Radius of the bob r = 0.9365 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	28	29	28.5	1.425	2.03	24.63
2	60	32	31	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	38	38	1.9	3.61	24.93
6	100	40	40	40	2	4	25

Average value of $\frac{l}{T^2}$ = 24.61 cm /s^2

Calculation :

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

$$= 4 X\ 3.14^2\ X\ 24.61$$

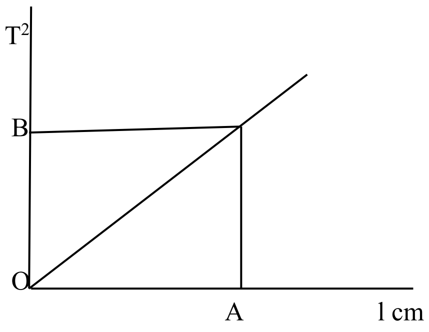
$$= 971.1\ cm/s^2$$

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

$$= \frac{980 - 971.1}{980} X 100 = 0.908\ \%$$

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



From graph

OA -- Length of seconds pendulum cm

Precautions :

The pendulum should oscillate with small amplitudes
The pendulum should oscillate in the vertical plane
Spinning oscillations are not considered

Result :

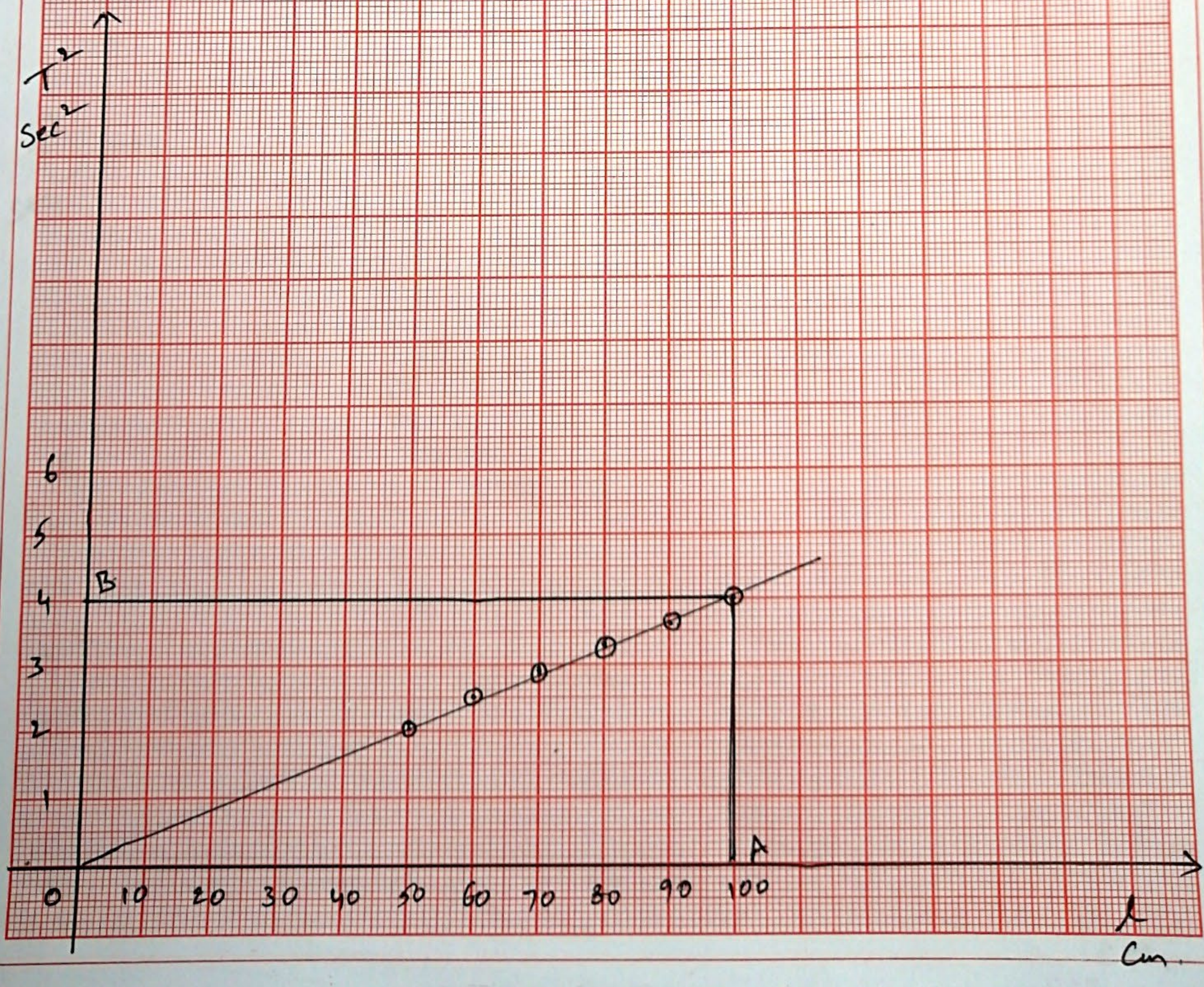
Acceleration due to gravity $g = 971.1$ cm/s^2
Percentage error in determine the value of $g = 0.908$ %
Length of seconds pendulum from $L - T^2$ graph = 100 cm

Set - I SIMPLE PENDULUM.

SCALE

on X-axis 1 unit = 10 cm

on Y-axis 1 unit = 1 sec^2



FORMULA :

To verify parallelogram law OC = OD cm

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

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	$\lfloor COD$
1	150	150	150	3	3	3	3	180
2	200	200	200	4	4	4	4	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	150	150	150	3	3	3	50	50	50
2	200	200	200	3	3	3	66.66	66.66	66.66

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 x Scale gm
1	150	150	W_2	3	3	2	100
2	200	200	W_1	4	4	4	200

Average weight of the stone in air W_1 = 200 gm
Average weight of the stone in water W_2 = 100 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 $W = \frac{P}{p} r$ gm
1	150	150	W_2	4	4	2.8	105
2	200	200	W_1	3	3	3	200

Average weight of the stone in air W_1 = 200 gm
Average weight of the stone in water W_2 = 105 gm

Calculation :

Average weight of the stone in air $W_1 = 200$ gm

Average weight of the stone in water $W_2 = 102.5$ gm

Volume $V = W_1 - W_2 = 97.5$ cc

Relative density $$d = \frac{W_1}{W_1 - W_2} = \frac{200}{97.5} = 2.0512$$

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 $V = 97.5$ cc
Relative density of the stone $d = 2.0512$

FORMULA :

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

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 $T = \dfrac{X}{20}\ s$	T^2 S^2
		Trail 1	Trail 2	Trail 3	Mean X sec		
1	100	16	16	16	16	0.8	0.64
2	150	19	19	19	19	0.95	0.9025
3	200	21.5	21.5	22	21.66	1.083	1.173

CALCULATION :

$$m_1 = 100\,gm \quad m_2 = 150\,gm$$
$$K = \frac{4\pi^2\,(m_2 - m_1)}{T_2^2 - T_1^2}$$
$$= \frac{4\,X\ 3.14^2\,(150-100)}{0.9025^2 - 0.64^2}$$
$$= 7519\ \ dyne/cm$$

$$m_1 = 150\,gm \quad m_2 = 200\,gm$$
$$K = \frac{4\pi^2\,(m_2 - m_1)}{T_2^2 - T_1^2}$$
$$= \frac{4\,X\ 3.14^2\,(200-150)}{1.173^2 - 0.9025^2}$$
$$= 7302\ \ dyne/cm$$

$$m_1 = 100\,gm \quad m_2 = 200\,gm$$
$$K = \frac{4\pi^2\,(m_2 - m_1)}{T_2^2 - T_1^2}$$
$$= \frac{4\,X\ 3.14^2\,(200-100)}{1.173^2 - 0.64^2}$$
$$= 7409\ \ dyne/cm$$

PRECAUTIONS :

Load should not be beyond elastic limit

Spring should be hanged to rigid support only.

Result : Force constant of given spring is K = 7409 dyne/cm

= 7.409 N/m

SURFACE TENSION OF A LIQUID

FORMULA: EXP 7 / S1

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

Where h = capillary raise of liquid = 5.832 cm

r = radius of bore = 0.024 cm

d = density of liquid = 1 gm/cc

g = acceleration due to gravity = 980 cm/s^2

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

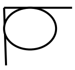
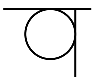
$$= \frac{1/20}{50} \quad = 0.001 \text{ cm}$$

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 $h = R_1 \sim R_2$ cm
1	8.45 + (23 x 0.001) 8.45 + 0.021 8.473	2.6 + (41 x 0.001) 2.6 + 0.041 2.641	5.832

TABLE :

Sl No.	Position of the cross wire	Microscope readings (M.S.R)+(V.C x L.C) cm	Diameter of the bore $d = R_3 \sim R_4$ cm	Radius of the bore $r = d/2$ cm
1		4.2 + (21 x 0.001) 4.2+0.021 4.221	0.048	0.024
2		4.25 + (19 x 0.001) 4.25 + 0.091 4.269		

CALCULATION:

Surface tension of given liquid $T = \dfrac{\left(h+\dfrac{r}{3}\right)rdg}{2}$ dyne / cm $= \dfrac{\left(5.832+\dfrac{0.024}{3}\right)0.024\,x1\,x980}{2}$

$= \dfrac{(5.832+0.008)23.52}{2}$ = 68.67 dyne/cm

PRECAUTIONS:-

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

RESULT: Surface tension of given liquid T = 68.67dyne/cm

APPARENT EXPANSION

FORMULA: EXP 8/ S1

Coefficient of apparent expansion $\gamma_a = \frac{m_2 - m_3}{(m_3 - m_1)(t_2 - t_1)}$ / ^{0}c

Where m_1 = mass of empty specific gravity bottle = 25.820 gm

m_2 = mass of specific gravity bottle + liquid =53.250 gm

m_3 = mass of specific gravity bottle + remaining liquid =52.640 gm

t_1 = initial temperature = 32 ^{0} c

t_2 =final temperature = 96 ^{0} c

TABLE :

CALCULATION :

Sl.no	Contents in pans		Turning points		Mean turning points		Resting point	Masss of the body
	Left	Right	Left	Right	Left	Right		
1	_______	_______	3 3 3	17 17	3	17	10 (Z.R.P)	________
2	Empty sp gravity bottle	20.000 5.000 0.500 0.200 0.100 0.020 25.820	2 3 3	15 15	2.66	15	8.83	25.820 (m_1)
3	Sp gravity bottle + liquid	50.000 2.000 1.000 0.200 0.050 53.250	6 6 6	19 19	6	19	12.5	53.250 (m_2)
4	Sp gravity bottle + remaining liquid	50.000 2.000 0.500 0.100 0.020 0.020 52.640	5 5 5	19 19	5	19	12	52.640 (m_3)

Coefficient of apparent expansion $\gamma_a = \frac{m_2 - m_3}{(m_3 - m_1)(t_2 - t_1)}$ / ^{0}c

$$= \frac{53.250 - 52.640}{(52.640 - 25.820)(96 - 32)}$$

$$= \frac{0.61}{26.82 x 64}$$ =0.000355 / ^{0}c

PRECAUTIONS :-

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

RESULT : Coefficient of apparent expansion = 0.000355 / ^{0}c

BOYLES LAW

FORMULA : EXP 9 / S1

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, $p\,l$ = constant

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

Table : To verify boyles law:

Sl.no	Position of the tube	Length of the air column l cm	$1/\ell$ cm^{-1}	Vertical heights		Difference in heights $h = h_1 - h_2$ cm	Pressure $p = H \pm h$ cm	$p\,l$ = constant
				h_1 cm	h_2 cm			
1		16.1	0.062	44.4	54.5	10.1	86.1	1386
2		16.5	0.060	47	54.9	7.9	83.9	1384
3		18	0.055	52.2	52.2	0	76	1368
4		20	0.050	53	46.5	-6.5	69.5	1390
5		21	0.047	54.5	44.4	-10.1	65.9	1383
6		19.4	0.051	54.1	49.5	- 4.6	71.4	1385

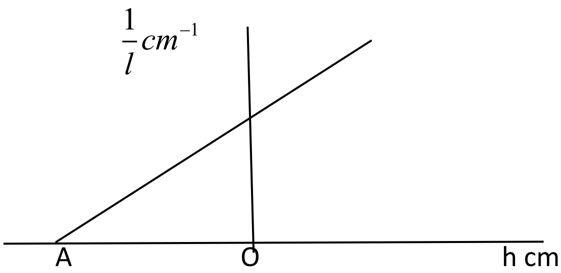
Where H = atmospheric pressure = 76 cm of Hg

$h = h_1 - h_2$ cm

***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.

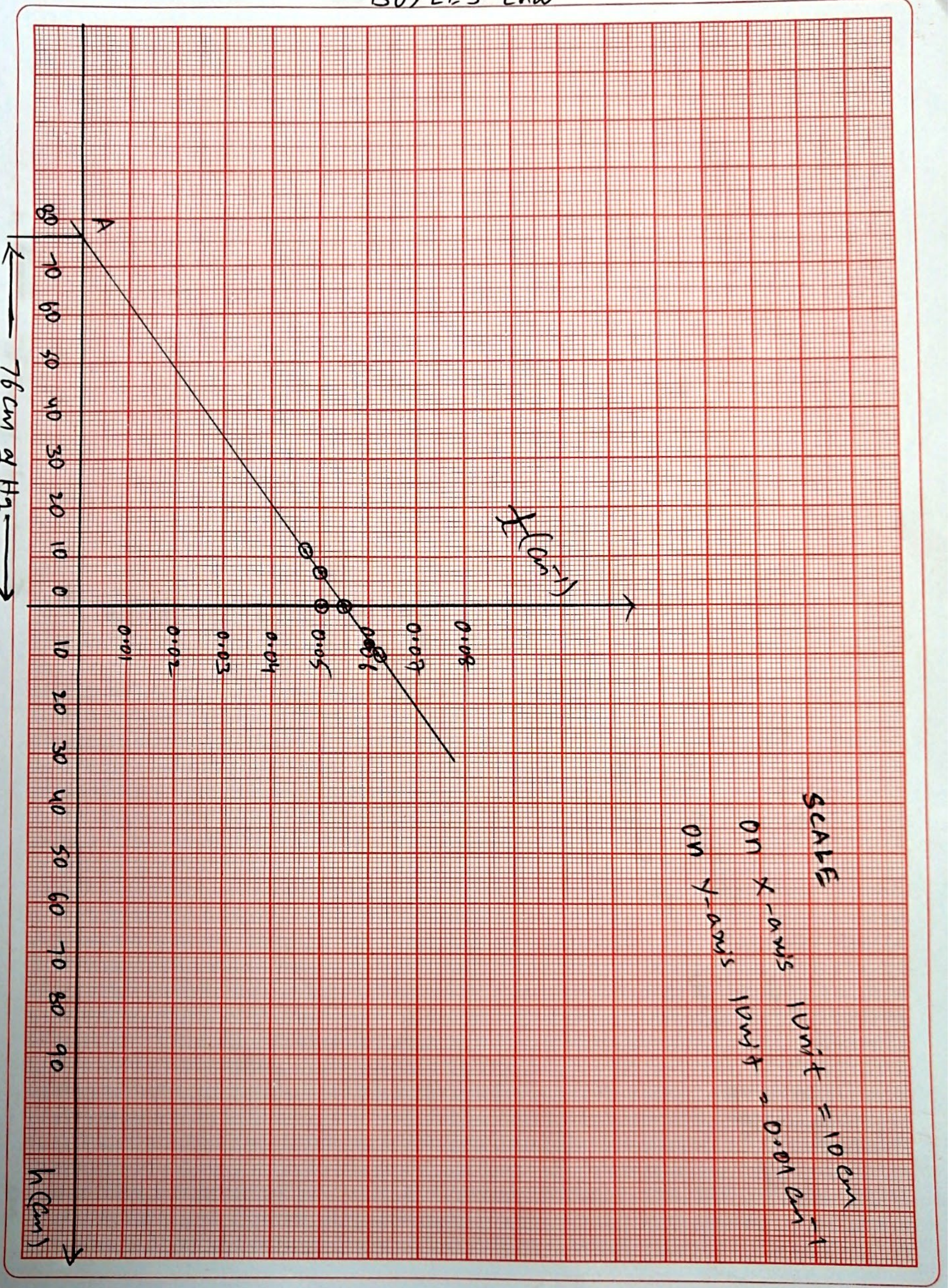
RESULT :

- Boyles law is verified.
- Atmospheric pressure from h-$1/l$ graph is 76 cm of Hg

Set I

Page No.

BOYLE'S LAW



SPECIFIC HEAT OF A SOLID

FORMULA: EXP 10 / S1

Specific heat of given solid $s = \dfrac{\left[m_1 s_1 + (m_2 - m_1) s_2\right](t_3 - t_1)}{(m_3 - m_2)(t_2 - t_3)}$ cal / gm ^{0}c

Where m_1 = mass of empty calorimeter + stirrer = 42.520 gm

m_2 = mass of calorimeter + stirrer + water = 130.650 gm

m_3 = mass of calorimeter + stirrer + water + solid = 152.560 gm

t_1 = initial temperature = 31 ^{0}c t_2 = temperature of solid = 94 ^{0}c

t_3 = resultant temperature = 34 ^{0}c S_1 = Specific heat of calorimeter =0.092 cal / gm ^{0}c

S_2 = Specific heat of water = 1cal / gm ^{0}c

Sl.no	*Contents in pans*		*Turning points*		*Mean turning points*		*Resting point*	Mass of the body
	Left	*Right*	*Left*	*Right*	*Left*	*Right*		
1	_______	_______	*1* *1* *2*	*19* *19*	*1.33*	*19*	*10.165* *(Z R P)*	-------------
2	mass of empty calorimeter + stirrer	*20.000* *20.000* *2.000* *0.500* *0.020* *42.520*	*2* *2* *2*	*16* *16*	*2.33*	*16*	*9.165*	42.520 (m_1)
3	mass of calorimeter + stirrer + water	*100.000* *20.000* *10.000* *0.500* *0.100* *0.050* *130.650*	*5* *5* *6*	*18* *18*	*5.33*	*18*	*11.665*	130.650 (m_2)
4	mass of calorimeter + stirrer + water + solid	*100.000* *50.000* *2.000* *0.500* *0.050* *0.010* *152.560*	*4* *4* *5*	*16* *16*	*4.33*	*16*	*10.165*	152.560 (m_3)

TABLE :

CALCULATION:

specific heat of given solid $s = \dfrac{\left[m_1 s_1 + (m_2 - m_1) s_2\right](t_3 - t_1)}{(m_3 - m_2)(t_2 - t_3)}$ cal / gm ^{0}c

$$= \frac{[42.520\,x\,0.092 + (130.650 - 42.520)1](34 - 31)}{(152.560 - 130.650)(94 - 34)}$$

$$= \frac{(3.912 + 88.13)3}{21.91\,x\,60} = 0.2101 \text{ cal / gm } ^0\text{c}$$

PRECAUTIONS :-

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

RESULT: Specific heat of given solid =0.2101 cal / gm ^{0}c

Velocity of Sound

Formula :- Exp:- 11/s1

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

Where n = frequency of tuning fork in Hz

l_1 = first resonating length in cm

l_2 = second resonating length in cm

Velocity of sound at 0°c $V_0 = V_t\left(1 - \frac{t}{546}\right)\ cm/s$

Where t = room temperature in ^0c = 28°c

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

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 $V_t = 2n(l_2 - l_1)\,cm/s$
		1st resonating length			2nd resonating length				
		Trail 1	Trail 2	Mean l_1 cm	Trail 1	Trail 2	Mean l_2 cm		
1	512	16	16.2	16.1	50.2	50	50.1	34.0	34816
2	480	17.6	17.7	17.65	54.8	54.9	54.85	37.2	35712
3	426	19.9	20.1	20	61.5	61.7	61.6	41.6	35443
4	n	15.8	15.8	15.8	49.7	49.9	49.8	34	--

Average value of V_t = 35323 cm/s

Calculation :

Velocity of sound at 0°c $V_0 = V_t\left(1 - \frac{t}{546}\right) = 35323\left(1 - \frac{28}{546}\right) = 33511\,cm/s$

Compare the frequencies of two forks $\frac{n_1}{n_2} = \frac{l_2^! - l_1^!}{l_2 - l_1} = \frac{37.2}{34} = 1.0941$

Precautions :-

1.The reading of water level mist 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 = 35323 cm/s

Velocity of sound at 0^0c is V_0 = 33511 cm/s

FORMULA :

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

Where u - object distance in cm

V - Image distance in cm

Focal length of mirror from infinite distance method f = 15 cm

Table :

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	20	60	0.05	0.016	15
2	25	37.5	0.04	0.026	15
3	30	30	0.033	0.033	15
4	35	26.2	0.028	0.038	14.98
5	40	24	0.025	0.041	15
6	45	22.5	0.022	0.044	15

Average focal length of the mirror f = 14.99 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 = 15 cm

Focal length of mirror from f = 14.99 cm

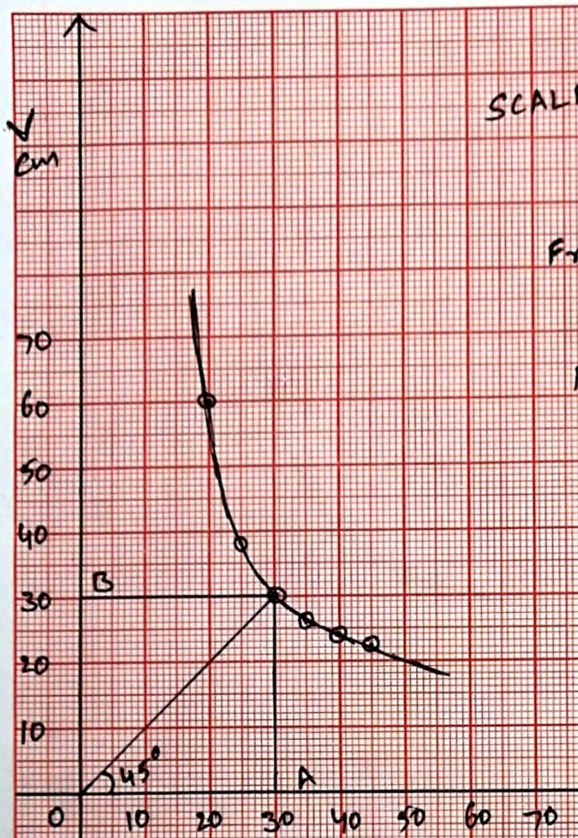
Focal length from u-v graph f = 15cm

Focal length from $\frac{1}{u} - \frac{1}{v}$ graph f =15.15 cm

Set - I

Page No.

CONCAVE MIRROR



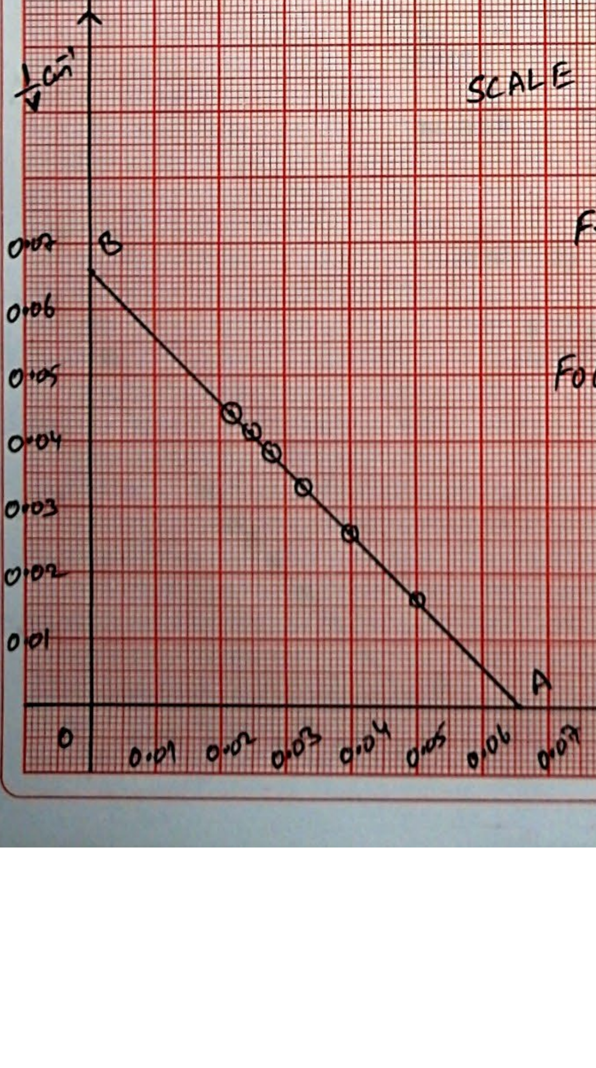
SCALE
on X-axis 1 unit = 10 cm
on Y-axis 1 unit = 10 cm

From graph OA = 30 cm
OB = 30 cm

Focal length $f = \frac{OA + OB}{4}$ cm

$= \frac{30 + 30}{4}$

$= \frac{60}{4} = 15$ cm.



SCALE on X-axis 1 unit = 0.01 cm^{-1}
on Y-axis 1 unit = 0.01 cm^{-1}

From graph OA = 0.066 cm^{-1}
OB = 0.066 cm^{-1}

Focal length $f = \frac{2}{OA + OB}$ cm

$= \frac{2}{0.066 + 0.066}$

$= 15.15$ cm

FORMULA:

Focal length of convex lens from u – v method $f = \dfrac{uv}{u+v}$ cm

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

Focal length of convex lens from lens displacement method $f = \dfrac{l^2 - d^2}{4l}$ 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	60	0.033	0.016	20
2	35	46.7	0.028	0.021	20
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 lens f = 19.99 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	Focal length $f = \frac{l^2 - d^2}{4l}$ cm
		1st position of lens d_1 cm	2nd position of lens d_2 cm		
1	82	32	46	14	19.9
2	84	31	49	18	20
3	86	30	50	22	20
4	88	29.5	55.5	26	20
5	90	29	59	30	20
6	92	28.5	61.5	33	20

Average focal length of the lens from lens displacement method f = 19.98 cm

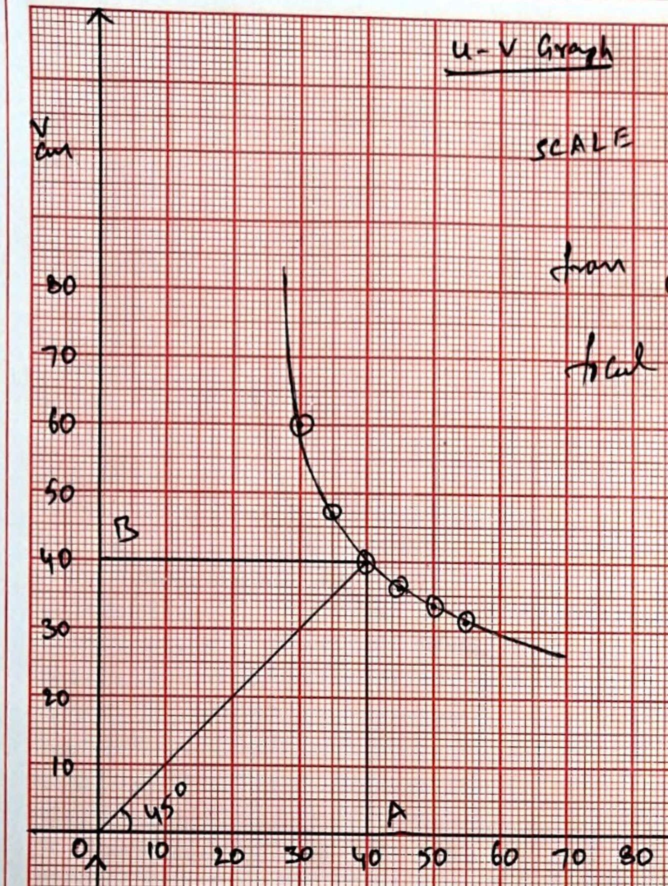
Precautions :

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 = 19.99 cm
Focal length of the lens from lens displacement method f = 19.98 cm
Focal length from u-v graph f = 20cm
Focal length from $\frac{1}{u} - \frac{1}{v}$ graph f =20cm

CONVEX LENS Set - I

u-v Graph



SCALE on x-axis 1 unit = 10 cm

on y-axis 1 unit = 10 cm

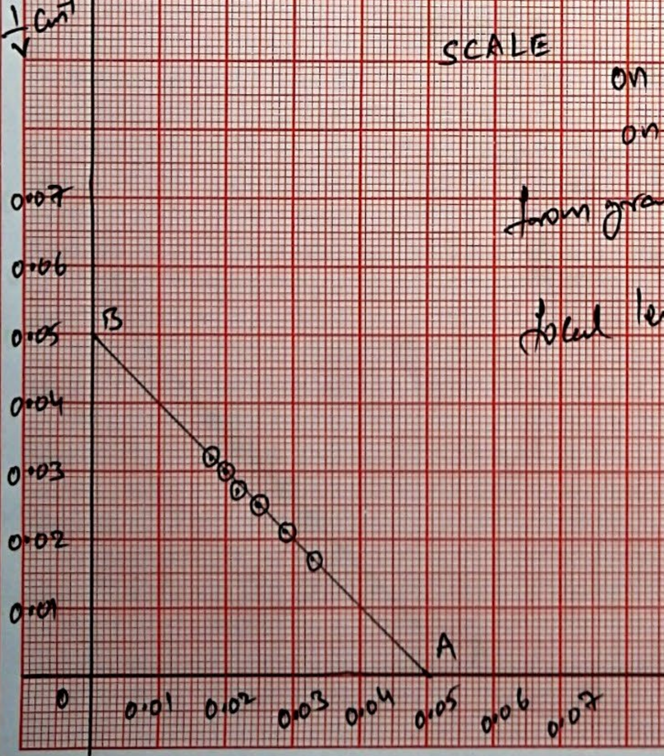
from graph OA = 40 cm OB = 40 cm

focal length $f = \frac{OA + OB}{4}$ cm

$= \frac{40 + 40}{4}$

$= \frac{80}{4} = 20$ cm.

$\frac{1}{u} - \frac{1}{v}$ Graph



SCALE on x-axis 1 unit = 0.01 cm^{-1}

on y-axis 1 unit = 0.01 cm^{-1}

from graph OA = 0.05 cm^{-1} OB = 0.05 cm^{-1}

focal length $f = \frac{2}{OA + OB}$ cm

$= \frac{2}{0.05 + 0.05}$

$f = 20$ cm

PRISM

EXP 15 / S1

Formula :-

Refractive index of the prism $\mu = \dfrac{\sin\left(\dfrac{A+D_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$ Angle of the prism $A = 2\tan^{-1}\left(\dfrac{\sin\left(\dfrac{D_m}{2}\right)}{\mu - \cos\left(\dfrac{D_m}{2}\right)}\right)$

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	53
2	35	47
3	40	41
4	45	38
5	50	40
6	55	45

Angle of minimum deviation D_m is = 38^0

Refractive index of the prism $\mu = \dfrac{\sin\left(\dfrac{A+D_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$ $\Rightarrow \mu = \dfrac{\sin\left(\dfrac{60+38}{2}\right)}{\sin\left(\dfrac{60}{2}\right)} = \dfrac{\sin 49}{\sin 30} = 1.509$

Angle of the prism

$$A = 2\tan^{-1}\left(\dfrac{\sin\left(\dfrac{D_m}{2}\right)}{\mu - \cos\left(\dfrac{D_m}{2}\right)}\right) \Rightarrow A = 2\tan^{-1}\left(\dfrac{\sin\left(\dfrac{38}{2}\right)}{1.5 - \cos\left(\dfrac{38}{2}\right)}\right) = 2\tan^{-1}\left(\dfrac{\sin 19}{1.5 - \cos 19}\right)$$

A = 60.6^0

Precautions :

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

Result :-

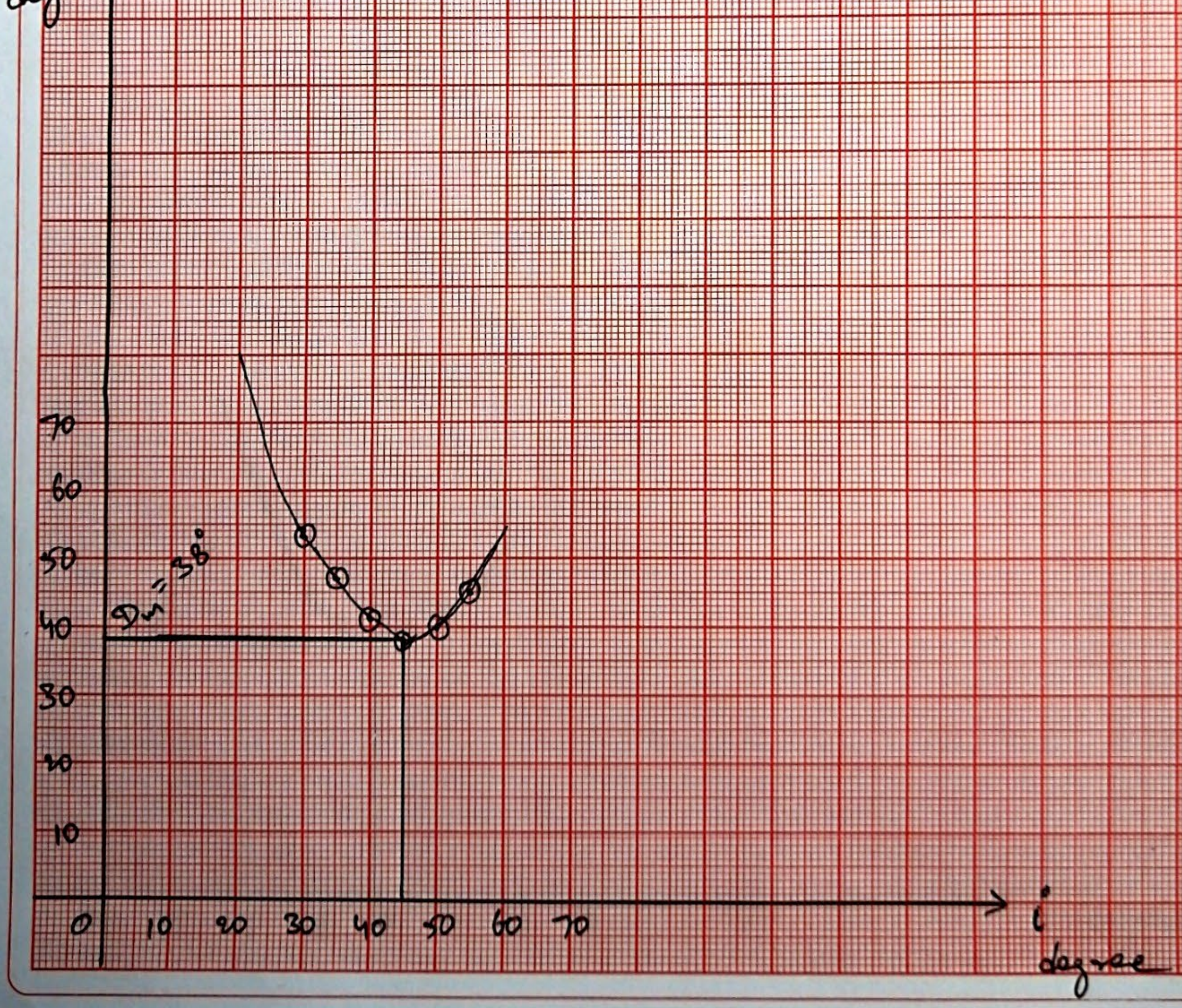
- Refractive index of the prism = 1.509
- Angle of the prism = 60.6^0
- Angle of minimum deviation from graph = 38^0

SCALE

on X-axis 1unit = 10 degree

on Y-axis 1unit = 10 degree

from graph Angle of minimum deviation $D_m = 38^\circ$



TANGENT GALVANOMETER

Formula :- Exp : 16/S1

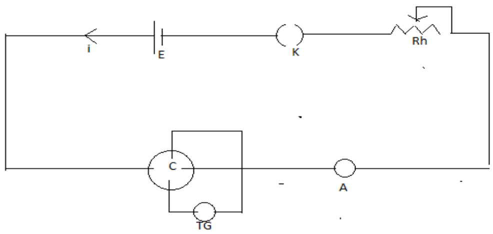
Strength of electric current flowing in the circuit $i = k\,Tan\theta$ A

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

r = radius of the coil = 51/2π = 8.11 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	36	36	33	0.649	1.59
2	2.0	37	37	41	41	39	0.809	1.98
3	2.4	42	42	48	48	45	1	2.45
4	2.8	47	47	51	51	49	1.15	2.81
5	3.2	52	52	54	54	53	1.32	3.23
6	3.4	54	54	54	54	54	1.376	3.372



$$k = \frac{10\,r\,H}{2\pi n} = \frac{10 \ x\ 8.11 \ x\ 0.38}{2 \ x\ 3.14\,x\ 2} = 2.45$$

Precautions :-

1 The compass is gently tapped on the glass top and then the deglections are noted
2 After adjusting the TG it should not be distrubed through out the experiment
3 The deflections must be taken between 30° to 60°

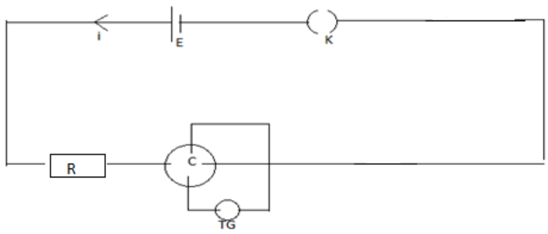
Result :-

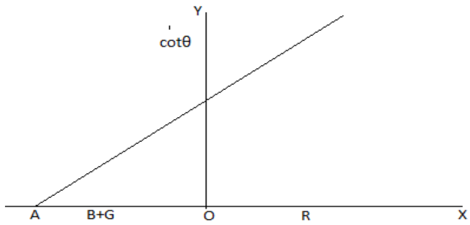
Strength of electric current is calculated and verified using ammeter
Reduction factor of TG k = 2.45 A

OHMS LAW

Formula :- Exp: 17/s1

To verify the Ohms law (R+B+G) Tan θ = 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 T G in degree





From graph value of (B+G) = 10 Ω

Table: verification of ohms law

S.No	Resistance in resistance box R Ω	Deflections in T G degree				Mean θ	Tanθ	Cotθ	(R+B+G)Tanθ = const
		θ_1	θ_2	θ_3	θ_4				
1	2	55	55	60	60	57.5	1.569	0.637	18.82
2	4	53	53	54	54	53.5	1.351	0.739	18.91
3	6	48	48	52	52	50	1.191	0.839	19.05
4	8	45	45	46	46	46.5	1.05	0.948	18.9
5	10	43	43	44	44	43.5	0.94	1.051	18.8
6	12	40	40	40	40	40	0.839	1.19	18.45

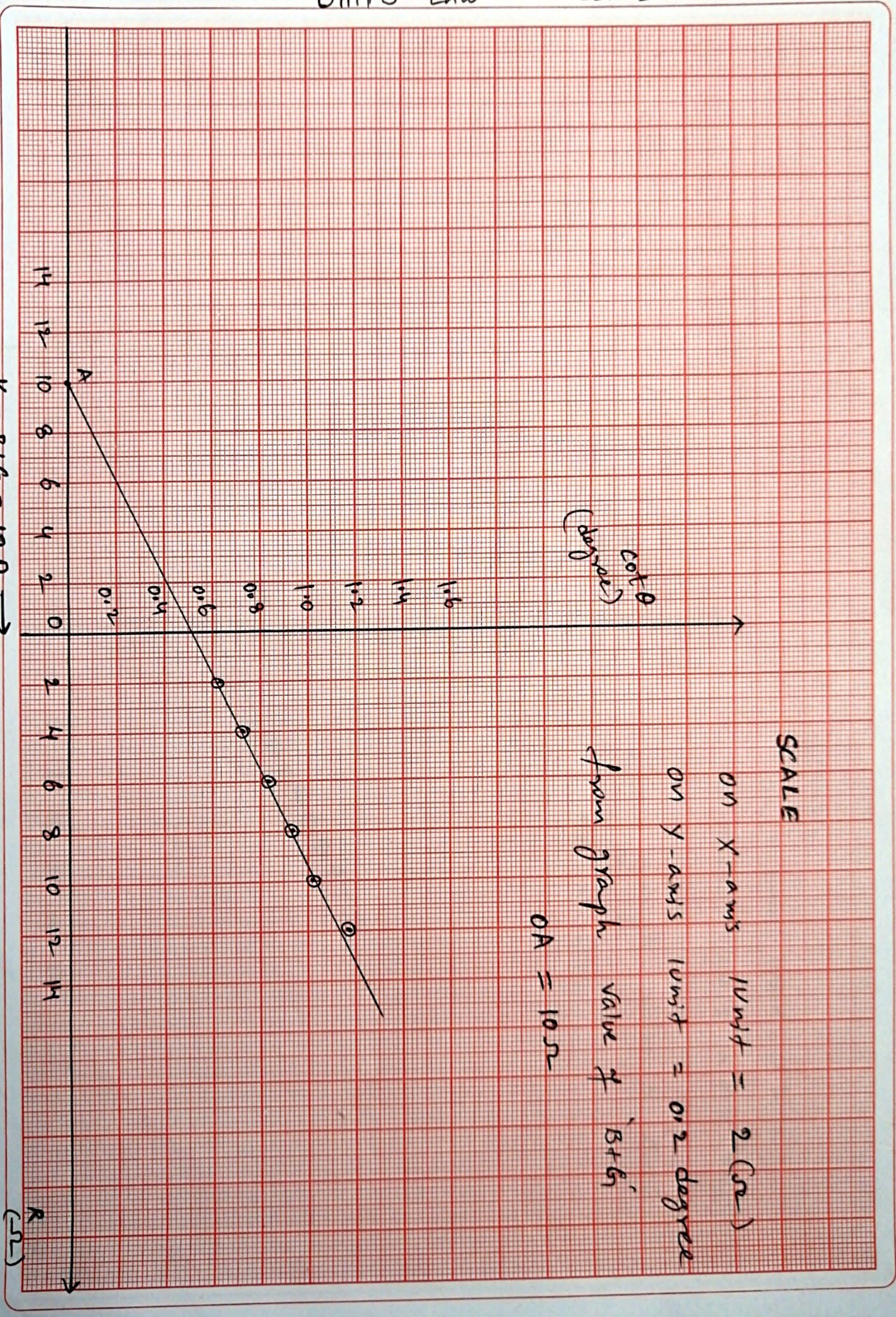
Precautions :-

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

Result :-

Ohms law is verified
Value of (B+G) from R-Cotθ graph is 10 Ω

OHM'S LAW Set I



METER BRIDGE

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

X - resistance of the unknown wire Ω

R – Resistance in the right gap Ω

l_1 - Balancing length from left in cm

l_2 - Balancing length from right in cm

X – resistance of the given wire Ω

r – radius of the wire in cm

l – length of the wire in cm

Individual resistance of 1st wire $R_1 = \frac{R_s + \sqrt{R_s^2 - 4R_sR_p}}{2}\ \Omega$ 2nd wire $R_2 = \frac{R_s - \sqrt{R_s^2 - 4R_sR_p}}{2}\ \Omega$

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

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

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

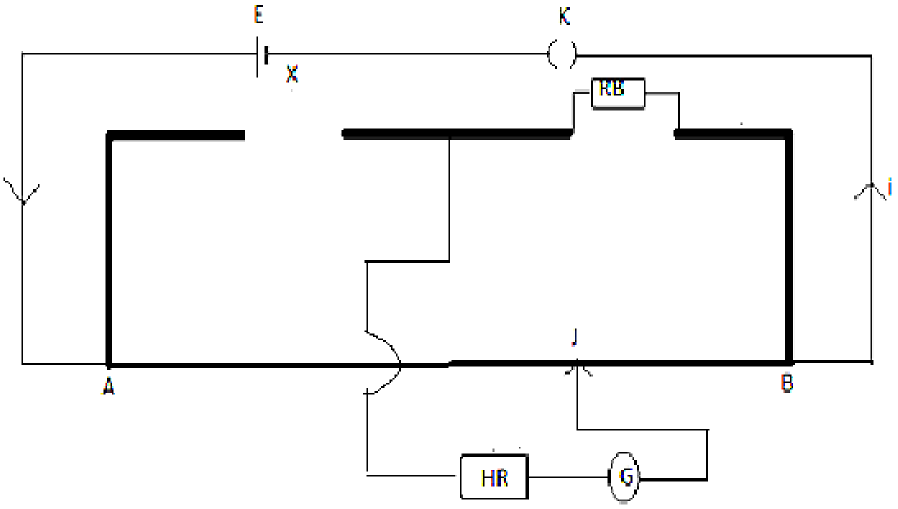


Table 1 To determine the radius of given wire

Error : -2 Correction : +2

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	3	5	0.05	1.05
2	1	2	4	0.04	1.04
3	1	3	5	0.05	1.05

Average diameter of the wire d = 1.046 mm = 0.104 cm

Radius of the wire r = 0.0523 cm

Table 2 : Determination of resistance of the wire

Sl.no	Resistance in the gaps		Balancing lengths		Resistance of the wire
	Left X Ω	Right R Ω	From left l_1 cm	From right l_2 cm	$x = R\left(\frac{l_1}{l_2}\right)$ Ω
1	X	4	58.6	41.4	5.66
2	X	6	49.5	51.5	5.76
3	X	8	41.2	58.8	5.60

Average resistance of the wire x=5.673 Ω

Specific resistance $\rho = x\,\frac{\pi r^2}{l}\ \Omega\ cm\ = 5.673x3.141x\left(0.0523\right)^2$

= 0.0004873 Ω cm.

Table 3 Determination of individual resistances of each wire

Sl.no	Combination of wires	Resistances in gaps		Balancing lengths		Resistance of combination
		Left X Ω	Right R Ω	Left l_1 cm	Right l_2 cm	$= R\frac{l_1}{l_2}$ Ω
1	Series	X	10	55.3	44.7	12.3
2		X	12	49.9	51.1	11.71
3		X	14	46	54	11.92
4	Parallel	X	2	58.5	41.5	2.819
5		X	4	43.5	56.5	3.079
6		X	6	32	68	2.823

Average resistance in series combination R_s = 11.97 Ω
Average resistance in parallel combination R_p = 2.907 Ω

Resistance of 1st wire $R_1 = \frac{R_s + \sqrt{R_s^2 - 4R_sR_p}}{2}\ \Omega$

$= \frac{11.97+\sqrt{11.97^2 - 4x11.97x2.907}}{2}$

= 6.997 Ω

Resistance of 2nd wire $R_2 = \frac{R_s - \sqrt{R_s^2 - 4R_sR_p}}{2}\ \Omega$

$= \frac{11.97-\sqrt{11.97^2 - 4x11.97x2.907}}{2}$

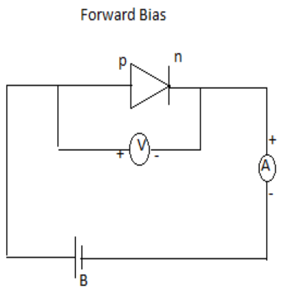
=4.973 Ω

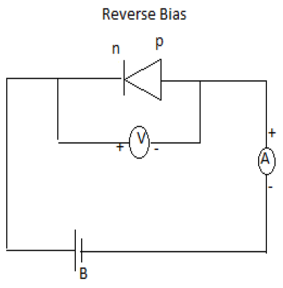
Precautions :- 1 . Jockey should not be dragged
2. Only small currents must be passed through the wire
3. The resistance in the gaps are to be nearly equal

Result :- Resistance of the given wire X = 5.673 Ω
Specific Resistance of the given wire s = 0.0004873 Ω cm
Individual resistances of two wires R_1 = 6.997 Ω
R_2 = 4.973 Ω

JUNCTION DIODE

CIRCUITS :- EXP 19/S1





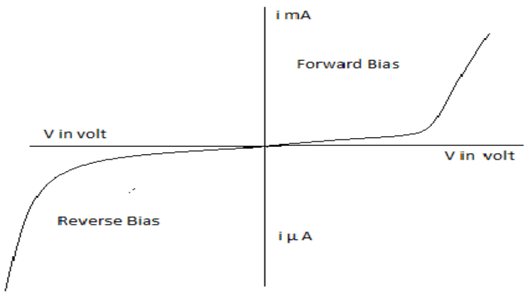


TABLE: Forward Bias

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	0.5
7	0.6	1.4
8	0.62	2.4
9	0.64	3.4

Reverse Bias

S.No	Voltage across diode V volt	Current through diode i µA
1	0	0
2	5	20
3	10	34
4	15	56
5	20	84
6	25	122
7	30	170
8	35	220

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 -I Page No.

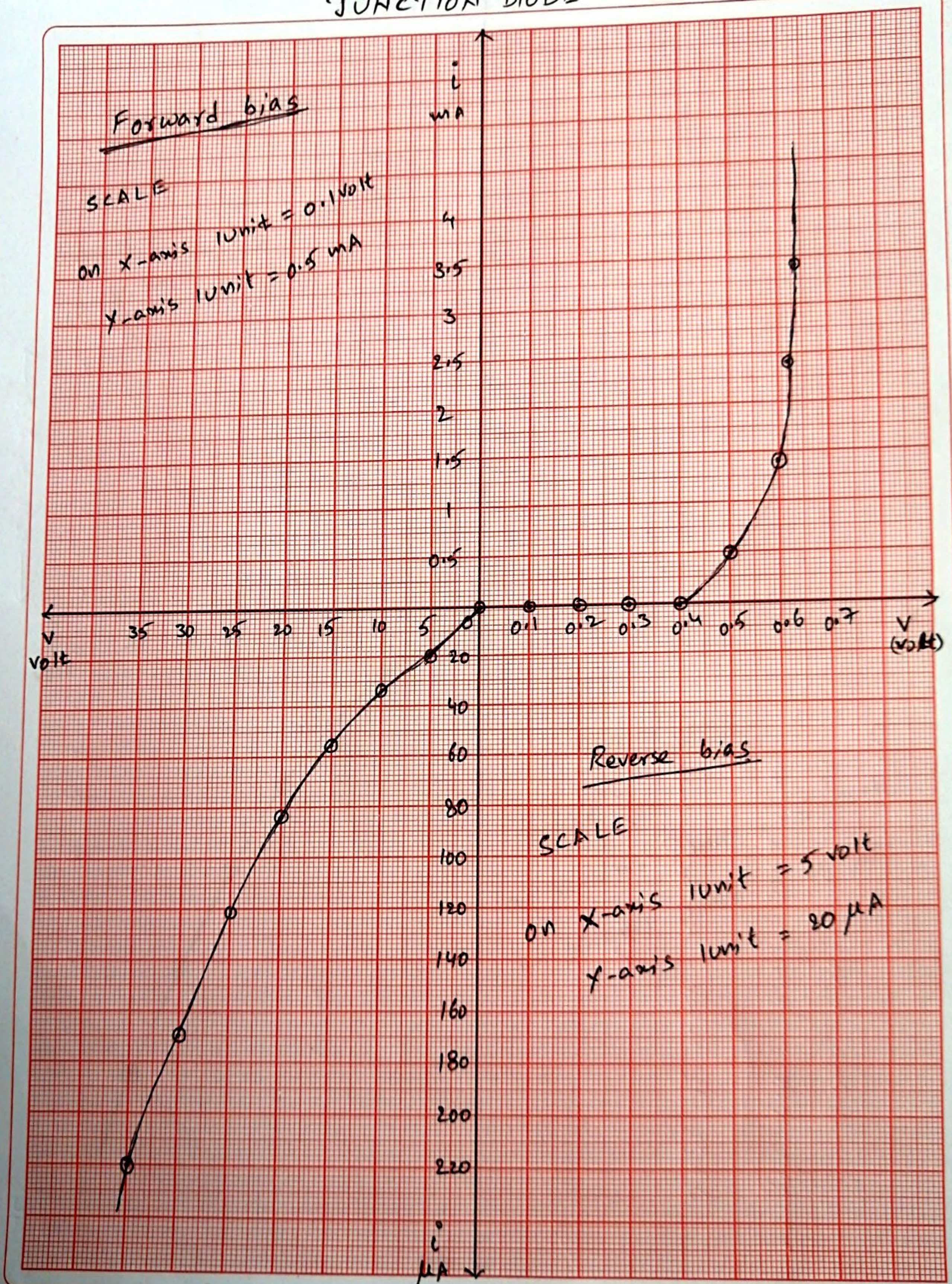


Table 1: INPUT CHARACTERSTICS :

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	100	0	0
3	200	0	0
4	300	0	0
5	400	0	0
6	500	15	0
7	600	130	20
8	700		170

Table 2: OUTPUT CHARACTERSTICS :

Sl.No	Voltage across Collector and emitter V_{CE} volt	Current through collector I_c m A	
		I_B = 10 μA	I_B = 20 μA
1	0	0	0
2	1	3	4
3	2	3	4
4	3	4	5
5	4	4	5
6	5	5	7
7	6	5	7
8	7	6	8

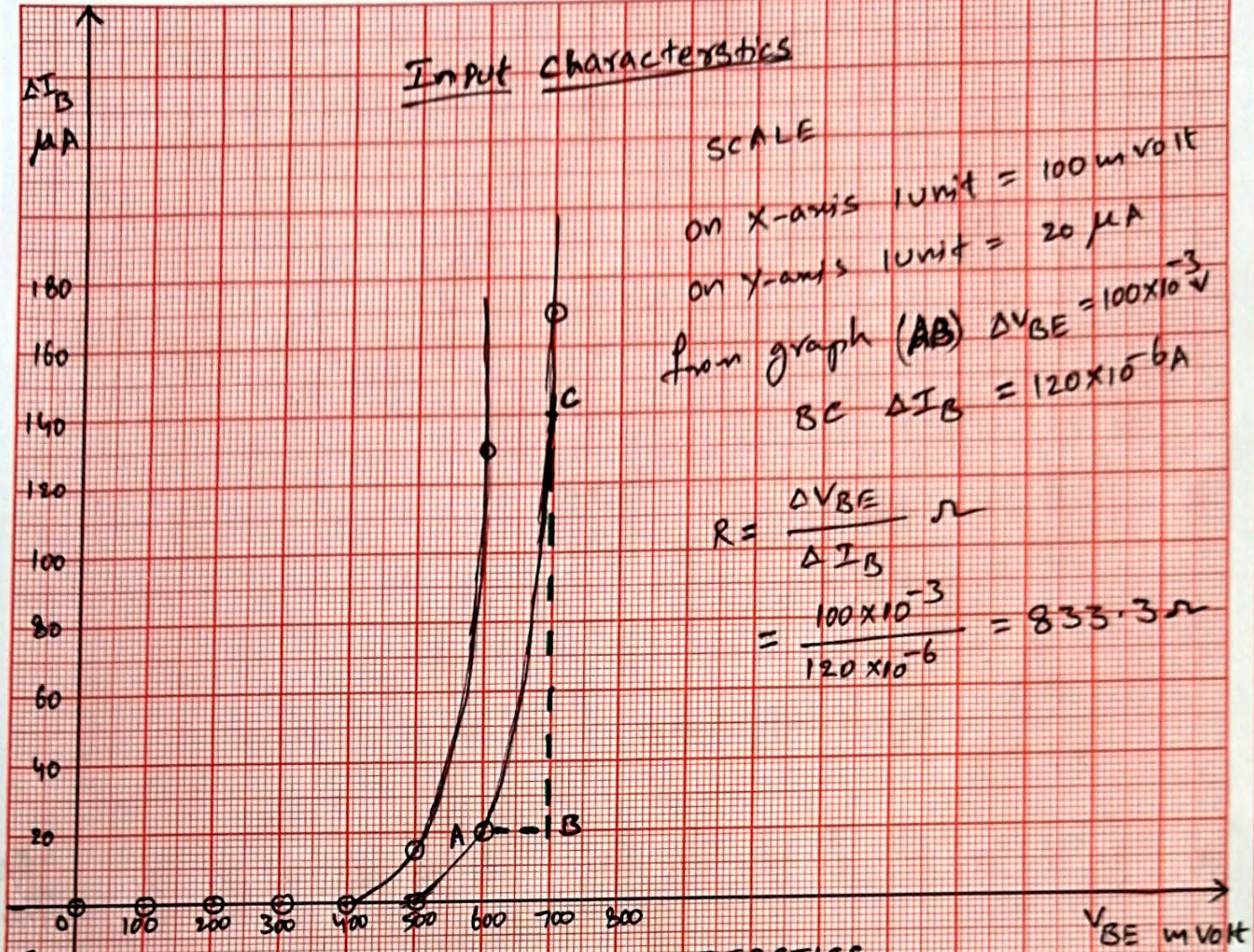
Table 3 : TRANSFER CHARACTERSTICS: V_{CE} = 1V

Sl no	I_B μA	I_C mA
1	0	0
2	10	1.5
3	20	3.5
4	30	5.5
5	40	7
6	50	9
7	60	11

Result: Input and Output characteristics of a P-N-P /N-P-N transistor are drawn
Input resistance 833.3Ω
Output resistance 2000Ω
Current gain β = 187.5

TRANSISTOR CHARACTERSTICS Set-I Page No.

Input characterstics



SCALE

on X-axis 1unit = 100 m volt

on Y-axis 1unit = 20 μA

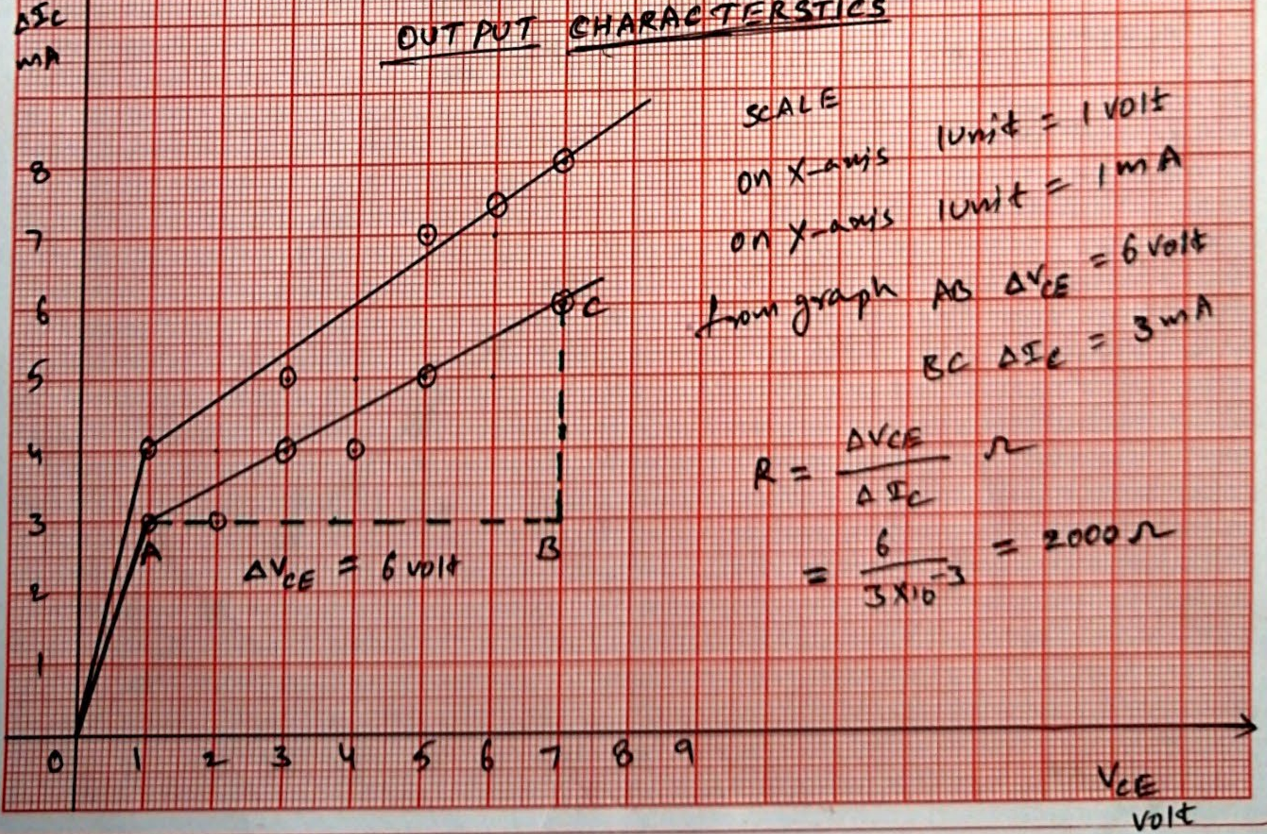
from graph ~~(AB)~~ $\Delta V_{BE} = 100 \times 10^{-3}$ V

BC $\Delta I_B = 120 \times 10^{-6}$ A

$$R = \frac{\Delta V_{BE}}{\Delta I_B}\ \Omega$$

$$= \frac{100 \times 10^{-3}}{120 \times 10^{-6}} = 833.3\ \Omega$$

OUTPUT CHARACTERSTICS



SCALE

on X-axis 1unit = 1 volt

on Y-axis 1unit = 1 mA

from graph AB $\Delta V_{CE} = 6$ volt

BC $\Delta I_C = 3$ mA

$$R = \frac{\Delta V_{CE}}{\Delta I_C}\ \Omega$$

$$= \frac{6}{3 \times 10^{-3}} = 2000\ \Omega$$

TRANSFER CHARACTERSTICS

SCALE

on X-axis 1unit = 10 μA

Y-axis 1unit = 2 mA

current gain $\beta = \frac{\Delta I_C}{\Delta I_B}$

$= \frac{3 \times 10^{-3}}{16 \times 10^{-6}}$

$= 0.1875 \times 10^{3}$

$= 187.5$

from graph

(AB) $\Delta I_B = 16 \mu A$

(BC) $\Delta I_C = 3 mA$