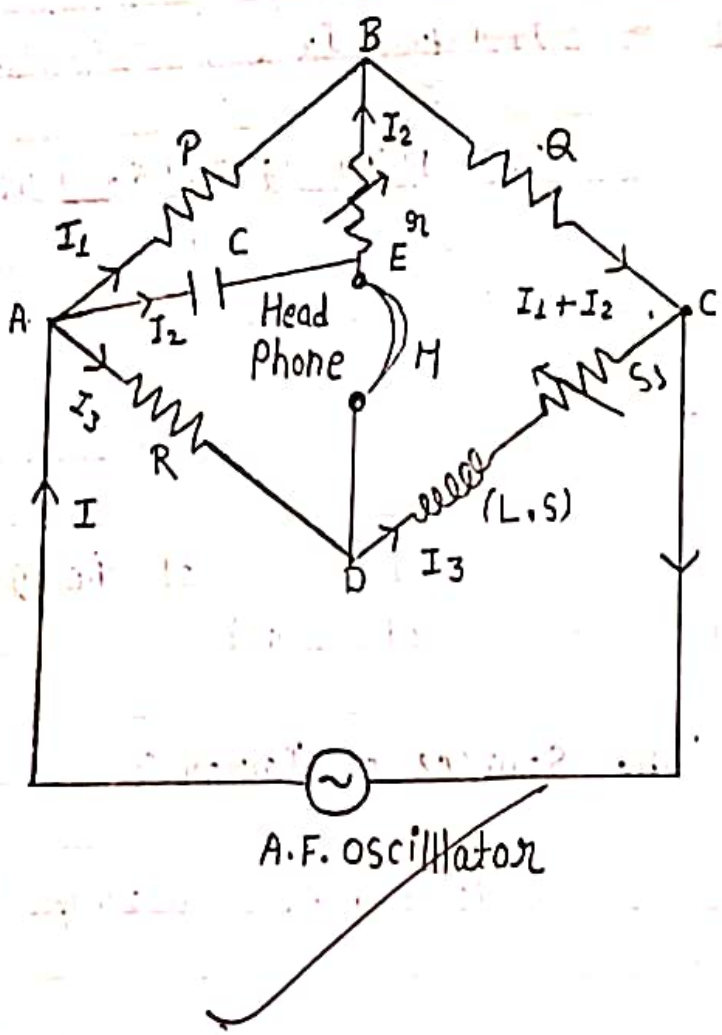
B
P
Q
I_2
I_1
C
E
g_n
A
I_2
Head
Phone
M
I_1+I_2
C
I_3
R
S
I
(L, S)
D
I_3
A.F. oscillator

Expt. No. Fifth

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☞ object :- To determine the self inductance of a coil by Anderson's method.

☞ Apparatus used :- Post office box, a small variable resistance, galvanometer, Oscillator, head phones, battery, plug keys, inductance box and connection wires.

☞ Formula used :- (i) When the bridge is balanced for D.C.,

$$S = \frac{RQ}{P}$$

(ii) When the bridge is balanced for A.C.

$$L = C\,[RQ + r(R+S)] \text{ henry}$$

☞ observation :-

Table for d.c. resistance, S, of the inductance coil

SNo	P	Q	R	S = RQ/P ohm
1.	10	10	x	x
2.	100	10	x	x
3.	1000	10	x	x

Teacher's Signature

Table for inductance L :

S.No	P [ohm]	Q [ohm]	R [ohm]	r [ohm]	L [Henry]	Mean L [milli henry]
1.	1000	1000	156	2870	105.144	
2.	1000	1000	122	3780	104.432	249.176
3.	1000	1000	110	2200	118.800	

* Calculations :- $L_1 = CR(2r+Q)$

$= 0.1 \times 156 (2 \times 2870 + 1000)$

$= 105.144 \text{ mH}$

$L_2 = 0.1 \times 122 (2 \times 3780 + 1000)$

$= 12.2 \times 8560$

$= 104.432 \text{ mH}$

$L_3 = 0.2 \times 110 (2 \times 2200 + 1000)$

$= 22 \times 5400$

$= 118800 \text{ mH}$

$L = \frac{L_1 + L_2 + L_3}{3}$

$= 112.392 \text{ mH}$

* Precautions and Sources of error :-

1. While obtaining D.C. balance, the galvanometer key should be pressed after battery key.
2. The capacitor should be of small capacity.

Teacher's Signature

Table for inductance L :

S.No	P [ohm]	Q [ohm]	R [ohm]	r [ohm]	L [Henry]	Mean L [milli henry]
1.	1000	1000	156	2870	105.144	
2.	1000	1000	122	3780	104.432	249.176
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$= 22 \times 5400$

$= 118800$ mH

$L = \frac{L_1 + L_2 + L_3}{3}$

$= 112.392$ mH

* Precautions and Sources of error :-

1. While obtaining D.C. balance, the galvanometer key should be pressed after battery key.
The capacitor should be of small capacity.

Teacher's Sign

Result :- The self inductance of given coil = 112.392 mH

Experiment No. 02

Object:- To determine the wavelength of laser beam using plane diffraction grating.

Apparatus:- Diode laser with power supply ($\lambda = 670$ nm visible red region), spectrometer (circular table, but without collimator and telescope, instead two holders are provided, one for holding the laser source and other for laser detector, diffraction grating (usual 15000 l/in), nanometer to measure the output current, spirit level etc.

Formula:-

$$(a+b)\sin\theta = n\lambda$$

$$\text{Wavelength } \lambda = \frac{(a+b)\sin\theta}{n}$$

λ = wavelength of laser

$(a+b)$ = grating element

n = order of spectra ($n = 1, 2$ etc)

θ = angle of diffraction for order n.

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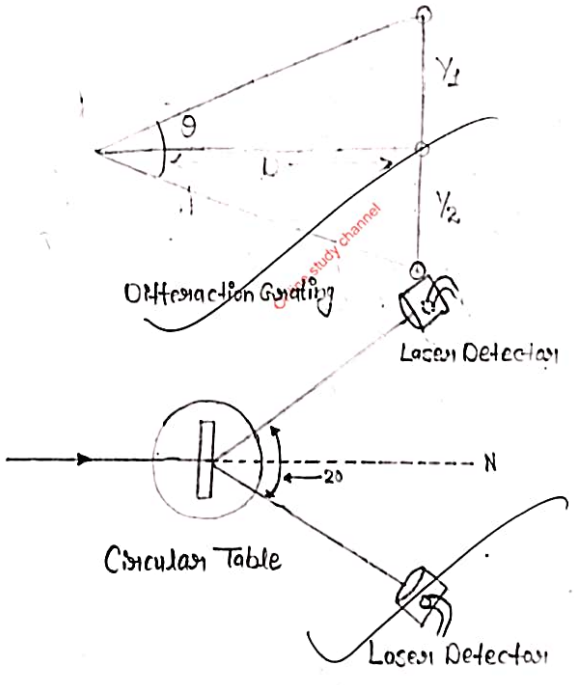

Observation Table :-

N = 15000 L.P.T.

V_1	V_2	$\frac{V_1+V_2}{2} = d$	D	θ
4.75	4	4.37	12.5	19.2696
4.5	3.25	3.77	10	20.65

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Claculation :-

$$n\lambda = \frac{\sin\theta}{N}$$

$$n=1$$

$$\lambda = \frac{\sin 19.2696 \times 2.54}{15000} \text{ cm}$$

$$\boxed{\lambda_1 = 5585 \text{ Å}}$$

$$\lambda_2 = \frac{\sin 20.65 \times 2.54}{15000}$$

$$\boxed{\lambda_2 = 5971 \text{ Å}}$$

$$\lambda_0 = \frac{\lambda_1 + \lambda_2}{2}$$

$$= \frac{5585 + 5971}{2}$$

$$= \frac{11556}{2}$$

$$\boxed{\lambda = 5778 \text{ Å}}$$

Result:-

The value of wavelength of the laser beam is found to be 5778 Å.

Sources of Error and precautions:-

1. Laser beam should not be looked at directly. It is hazardous to the eyes.
2. Even looking at the specular reflections from smooth surface should be avoided.
3. The laser is to be switched off after noting observations or when not required.
4. The laser and its power supply should never be tampered with when it is in 'ON' condition. The current is of the order of 10 mA at 2KV.
5. Laser experiments are to be performed only in the presence of the teacher.

Teacher's Signature : .....

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Experiment No. 5

Object :—

To determine the Na light by Newton's method.

Apparatus :—

Newton ring set Na lamp plane glass plane, convex lense, reading lense, lamp, travelling microscope.

Formula used :—

The above length Na light is given by

$$\lambda = \frac{D^2_{n+p} - D^2_n}{4pR}$$

Where,

D_{n+p} = diameter of $(n+p)^{th}$ dark ring

$D_{(n+p)} = (n+p)^{th}$

D_n = diameter of n^{th} constant

R = Radius of curvature of plane convex lense.

Observation :—

Least count of microscope 0.001 cm table for the determination of

$$D^2_{(n+p)} - D^2_n$$

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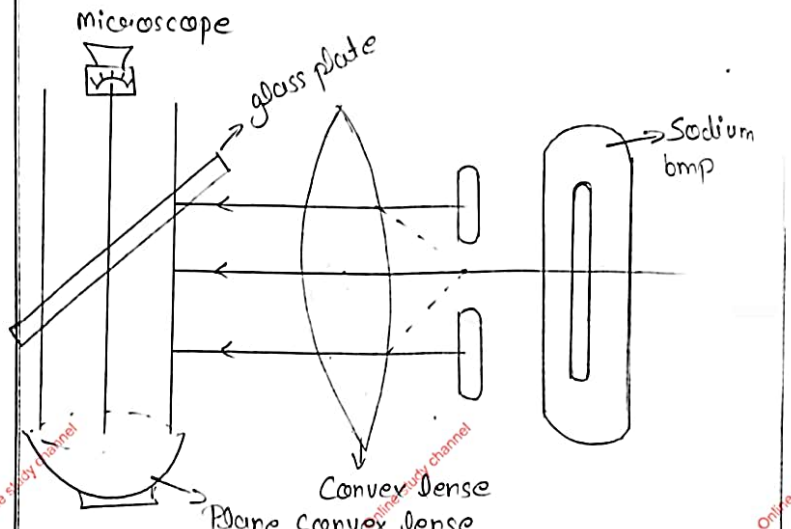

Newton's Ring

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S.No.	No. of the ring	Micrometer reading Left end a cm	Right end b cm	Diameter D(b-a)	(n+p)	$D^2_{m+p} - D^2_n$ mean	Value
1	20	6.480	5.816	0.664	0.490		
2.	19	6.471	5.831	0.690	0.410		
3.	18	6.469	5.831	5.832	0.400		
4.	17	6.953	5.833	5.833	0.389		
5.	16	6.945	5.834	5.834	0.389		
6.	15	6.932	5.878	5.830	0.375		
7.	14	6.420	5.900	5.900	0.362		
8.	13	6.402	5.907	5.907	0.298	0.207.	8
9.	12	6.398	5.921	5.921	0.252		
10.	11	6.372	5.942	5.942	0.228		
11.	10	6.360	5.952	5.956	0.201		
12.	09	6.398	5.956	5.976	0105		
13.	08	6.339	5.976	5.968	0.159		
14.	07	6.321	5.968	5.968	0.199		
15.	06	6.82	5.986	5.986	0.131		
16.	05	6.316	5.994	5.994	0.112		

Radius of curvature of plane convex lense = 100 cm

Calculation :—

The wave length of sodium light

$$\lambda = \frac{D^2_{(n+p)} - D^2_n}{4PR}$$

$D^2_{(n+p)} - D^2_n = 0.207$ $\quad P = 8$

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$R = 100$

$$\lambda = \frac{0.207}{4 \times 8 \times 100}$$

$\lambda \approx 5788\ A^\circ$

The wave length sodium light $\approx 6968\ A^\circ$

Precaution :—

1. Every glass wire should be linear and clean.
2. Cross wire should be touched negatively microscope should be move in one dection one only.
3. The radius curvature of plane convex should be large.

Object :— To determine the wave length of Na light (monochromatic source) with the help of Fresnel's Biprism.

Apparatus used :— Optical bench Na lamp biprism convex lamp, slit and micrometer etc.

Formula Used :- The wave length of Na light is given by can biprism experiment

$$\lambda = \frac{\beta \cdot 2d}{D}$$

where β = Fringe Width

$2d$ = distance between the two virtual sources.

D = distance between the slit and source screen.

$$2d = \sqrt{d_1 \cdot d_2}$$

d_1 = distance between the two images formed by the convex lens in one position

d_2 = distance between the two images formed by the convex lens in Second position

Observation :—

① Table for the motion of B list const of the micrometer source.

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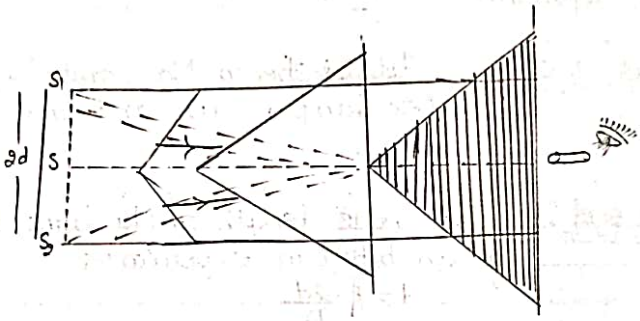

Foresnel's Biprism

S.No.	Micrometer reading (a) M.S	V.S (cm)	Total cm	No of fringes	Micrometer reading M.S	V.S	Total cm	Difference 20th fring	Mean for fringe	B-mean
1.	1.30	0.024	1.324	21	1.85	0.024	1.874	0.550		
2.	1.35	0.028	1.378	22	1.90	0.034	1.934	0.556		
3.	1.40	0.014	1.414	23	1.95	0.018	1.968	0.554		
4.	1.45	0.030	1.480	24	2.00	0.024	2.024	0.544		
5.	1.50	0.030	1.530	25	2.05	0.24	2.074	0.544		0.627
6.	1.55	0.021	1.511	26	2.10	0.014	2.114	0.543	6.58	
7.	1.60	0.018	1.618	27	2.15	0.020	2.170	0.552		
8.	1.65	0.034	1.684	28	2.20	0.026	2.226	0.542		
9.	1.70	0.020	1.720	29	2.25	0.032	2.292	0.562		
10.	1.75	0.025	1.775	30	2.30	0.013	2.317	0.542		

(ii)

Table for determination of 2d.

S.N	Micrometer reading 1st position of lens I Image	II Image	d1	2nd position of lens I Image	II Image	d2	2d = √(d1 d2)	mean
1.	1.362	1.434	0.072	1.514	1.734	0.620	1.26	
2.	1.362	1.436	.074	1.518	1.786	0.260	0.139	0.139
3.	1.362	1.436	.074	1.516	1.826	0.310	0.153	

Calculation :- $d = \beta \frac{2d}{D}$

$\beta = 0.027$ $2d = 0.139$

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$D = 65.4$

$d = 0.027$

position of the slit = 12cm

position of the eye price = 77.4cm

$D = 77.4 - 12.0$

$D = 65.4$cm

Result :-

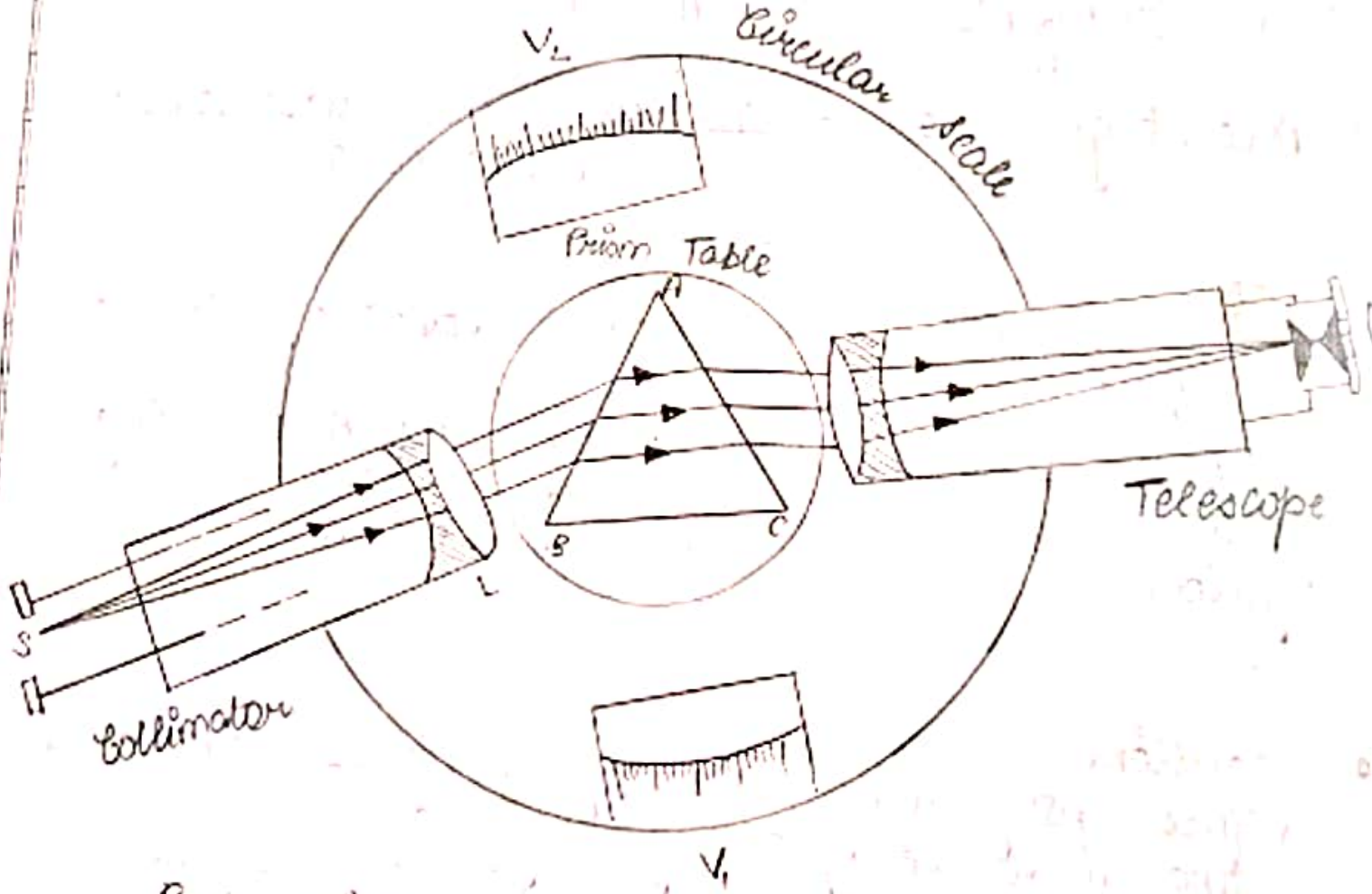
Wave length of the Na length = 55.66Å × 160.153

Standard Value = 5893

Error = $\frac{E \times 100}{\text{Standard}}$ = 5.5%.

Precaution :-

1. Slit should be vertical the bench should have Na error
2. Fringe slit should be removed
3. The value of D should be large
4. The motion is eye piece should be the length of bench



Ray diagram of dispersion of light through prism

Experiment-02

- **Aim**
To determine the dispersive power of a prism using spectrometer.

- **Apparatus Required**
Spectrometer, flint glass prism (or hollow prism), spirit level, mercury vapour lamp with wooden enclosure and a reading lens.

- **Theory and Formula**
The refractive index of the material of a prism is given by the formula :-

$$\mu = \frac{\sin\frac{A+\delta m}{2}}{\sin\frac{A}{2}}$$

where A = Angle of prism
δm = Angle of Minimum deviation for a particular colour for example Violet or Red or Yellow.

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Table for A

Vernier Scale	Reflection from AB MSR	VSR	TR(X)	Reflection from AC MSR	VSR	TR(Y)	X-Y = 2A degree
V_L	121°	6'	121.6°	241	37	241.31°	119.7°
V_R	301°	9'	301.9°	~~120~~ 60	37	61.37° 420.2°	120.1°

Table for δm

S. No.	Colour	Vernier	Readings in Minimum Deviation Position M.S.	V.S.	TR(a)	Readings in Direct Image Position M.S.	V.S.	TR(b)	δm = a-b	Mean δm degree.
1.	Violet	V_L	287°	20	287.3°	335°	20	335.53°	48°	48°
		V_R	108°	40	108.6	156°	20	156.3°	48°	
2.	Yellow	V_L	283°	30	283.5°	335°	20	335.3°	51.8°	51.75°
		V_R	104°	40	104.6	156°	20	156.3°	51.7°	
3.	Red	V_L	283°	5	283.0°	335°	20	335.3°	52.3°	52.25°
		V_R	104°	10	104.1	156°	20	156.3°	52.2°	

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- **Calculations**

The refractive index is $\mu = \dfrac{\sin\frac{A+\delta m}{2}}{\sin\frac{A}{2}}$.

μ_V = 1.6852

μ_R = 1.6434

μ_Y = 1.6499

Dispersive power $\omega = \dfrac{\mu_v - \mu_r}{\mu_y - 1} = 0.0643$

- **Result**

The dispersive power of the given prism ω' =
Standard value of $\omega = 0.015$
Percentage error $= \dfrac{\omega' - \omega}{\omega} \times 100\% = \dfrac{0.0643 - 0.05}{0.05} \times 100 = 28.6\%$

- **Precautions**

1. Adjustment of telescope, collimator and prism table should be done accurately.
2. The height of prism should be so adjusted that light falls on the whole refracting surface of the prism.
3. At the time of taking observations the telescope and the prism table should be clamped.

Experiment No. → 1

Object → To determine the resolving power of prism.

* Apparatus Used → An adjustable micrometer slit, a prism, a eyepiece, spectrometer, vernier scale, mercury lamp.

Formula used → Resolving power of prism is given by:-

$$R.P = t \cdot \frac{d\mu}{d\lambda}$$

$$\mu = \frac{\sin\left(\frac{A + \delta m}{2}\right)}{\sin(A/2)}$$

Where,

A = Angle of the prism

δm = Angle of minimum deviation

t = thickness of prism.

λ = wavelength of light.

* Observation → value of one division of main scale =

Total no. of division on vernier scale =

Least count of spectrometer =

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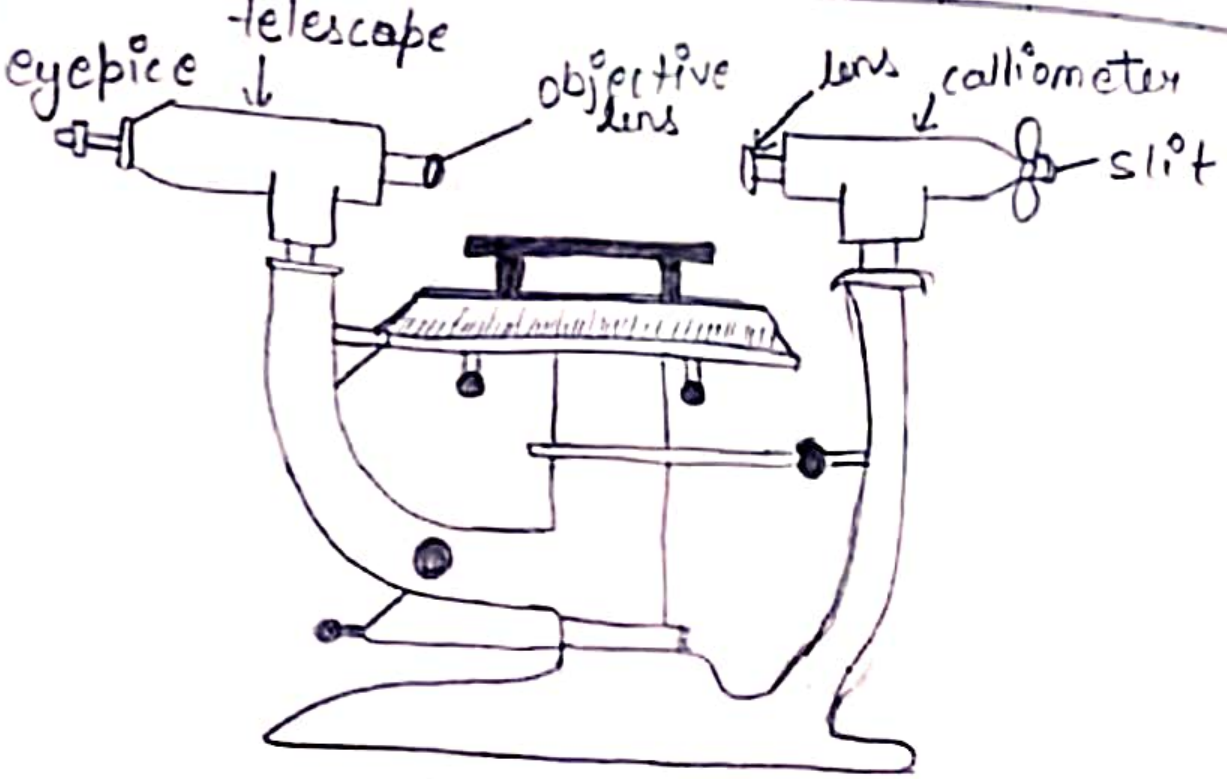
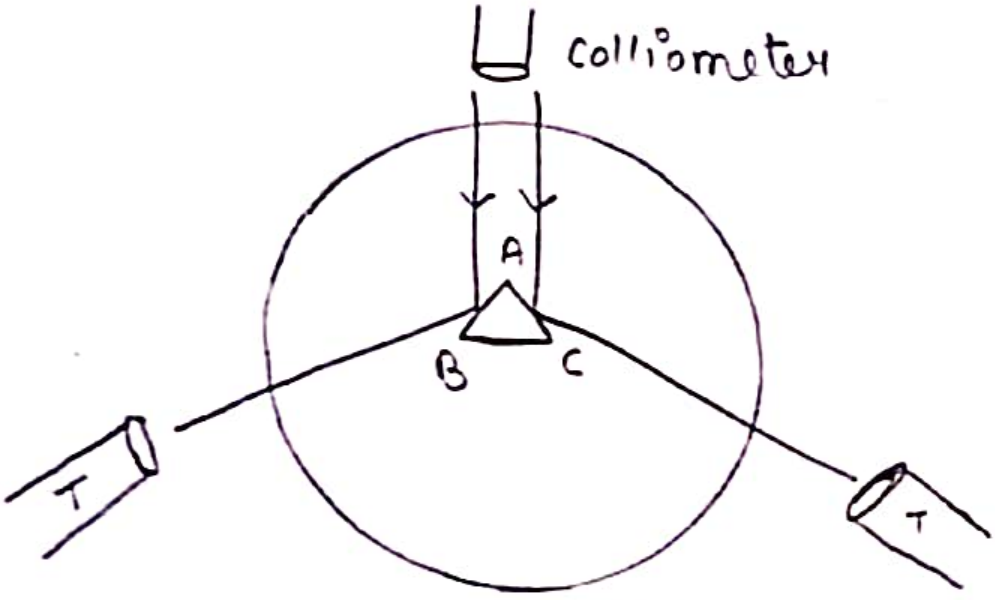
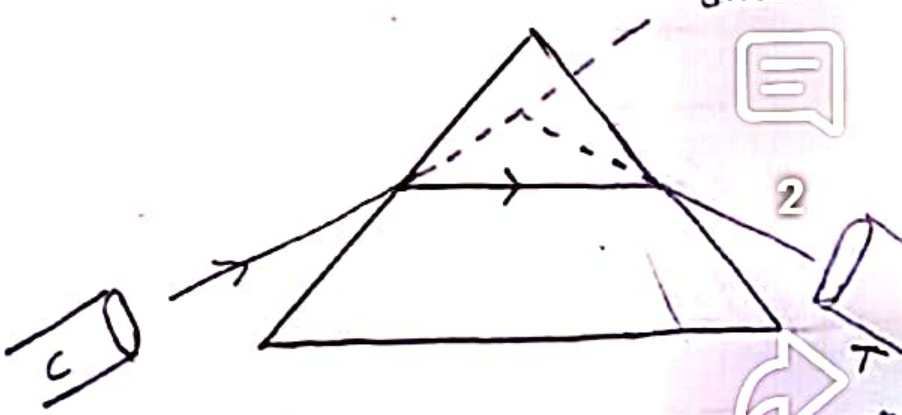


spectrometer



Angle of prism



Angle of minimum devi

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Page No. 2

1.) Table for angle of prism (A) -

SNO	Vernier	Position of Image reflected form AB Phase			Position of Image reflected from AC Phase			2A (a-b)	A	Mean A
		M.S	V.S	Total	M.S	V.S	Total			
1.	V_1	317°	24'	317°24'	198°	12'	198°12'	118°12'	59°36'	60°
	V_2	139°	15'	139°15'	17°	13'	17°13'	122°2'	61°1'	

2.) Table for minimum deviation (δ_m) -

SNO.	Colour	Vernier	angle of deviation			ange of direct Image			deviation (a-b)	mean
			M.S	V.S	Total	M.S	V.S	Total		
1.	Violet	V_1	17°	10'	17°10'	136°	12'	136°12'	139°2'	133°
		V_2	197°	10'	197°10'	396°	10'	396°10'	139°	
2.	Green	V_1	160°	17'	16°17'	156°	12'	156°12'	140°1'	140°
		V_2	136°	8'	136°8'	336°	10'	336°10'	140°2'	
3.	Red	V_1	16.5°	12'	16.42'					
		V_2	195°	10'	195.10					

3.) Table for the thickness of prism

Least count of vernier callipers = 0.01

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Scale

at x-axis = 1 small box represents 0.00025 Å

at y-axis = 1 small box represents 50 × 10⁻⁶ cm

1.975

1.970

1.965

1.960

1.955

1.950

1.945

1.940

violet

blue

green

yellow

red

1000 2000 3000 4000 5000 6000 7000

from the above graph

NO	Main scale Reading	vernier scale Reading	Total (a+b)	mean (t)
1	3·3	4 x 0·01	3·34	3·34
2	3·3	4 x 0·01	3·34	
3	3·3	5 x 0·01	3·35	

Calculation from Graph –

$d\mu = AB = 0.004$ $\quad d\lambda = BC \Rightarrow 1000 \times 10^{-8}$

& we have $t = 3.34$ cm

$$R.P = \frac{t \cdot d\mu}{d\lambda} = \frac{3.34 \times 0.004}{1000 \times 10^{-8}}$$

taking log on both side we get

$\log R.P = \log 3.34 - \log 0.004 - \log 1000 + 8 \log$

$\log R.P = 0.5237 - 2.3979 - 3 + 8$

$\log R.P = 3.1252$

Taking antilog, $\boxed{R.P = 1.305 \times 10^3}$

① Result → Resolving power of prism for beer found to be $(1.305 \pm 0.8) \times 10^3$

② Precautions →

① slit should be narrow as possible

② Both vernier should be read.

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Calculation

(1) $\mu_r = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin A/2}$

$= \frac{\sin\left(\frac{60°18' + 139°1'}{2}\right)}{\sin\left(\frac{60°18'}{2}\right)}$

$\mu_r = \frac{\cos 9°34'}{\sin 30°9'}$

taking log both side

$\log \mu_r = \log(\cos 9°34') - \log(\sin 30°9')$

$\log \mu_r = -1 + 0.9934 - (-1 + 0.7009)$

$\log \mu_r = -1 + 0.9934 + 1 - 0.7009$

$\log \mu_r = 0.2930$

taking antilog

$\boxed{\mu_r = 1.964}$

(2) $\mu_g = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin A/2}$

$= \frac{\sin\left(\frac{60°18' + 140°1'}{2}\right)}{\sin \frac{60°18'}{2}}$

$\mu_g = \frac{\cos 10°8'}{\sin 30°9'}$

Taking log both si

$\log \mu_g = \log(\cos 10°8')$

$\log \mu_g = -1 + 0.9932 - (-1$

$\log \mu_g = -1 + 0.9932 + 1 - 0$

$\log \mu_g = 0.2923$

taking antilog

$\boxed{\mu_g = 1.9}$

(3) $\mu_H = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin A/2} = \frac{\sin\left(\frac{60°18' + 141°1'}{2}\right)}{\sin \frac{60°18'}{2}} \Rightarrow \frac{\sin 100°31'}{\sin 30°9'}$

$\mu_H = \frac{\cos 10°31'}{\sin 30°9'}$

taking log we get

$\log \mu_H = \log(\cos 10°31') - \log(\sin 30°9')$

$\log \mu_H = -1 + 0.9927 - (-1 + 7009)$

$\log \mu_r = 0.2918$

taking antilog $\Rightarrow \boxed{\mu_r = 1.958}$

Most Probable Error

$R.P = \pm \frac{d\mu}{dr}$

Taking log and differentiating partially, we get

$\frac{S.R.P}{R.P} = \frac{\delta t}{t} + \frac{\delta \mu}{\mu} + \frac{\delta A}{\lambda} = \frac{0.01}{3.34} + \frac{0.00025}{0.0004} \ldots \frac{5}{1000}$

$\frac{S.R.P}{R.P} = 0.0029 + 0.625 + 0.0005 \times R.P \Rightarrow 0.628$

$\boxed{S.R.P = 0.82 \times 10^{5}}$