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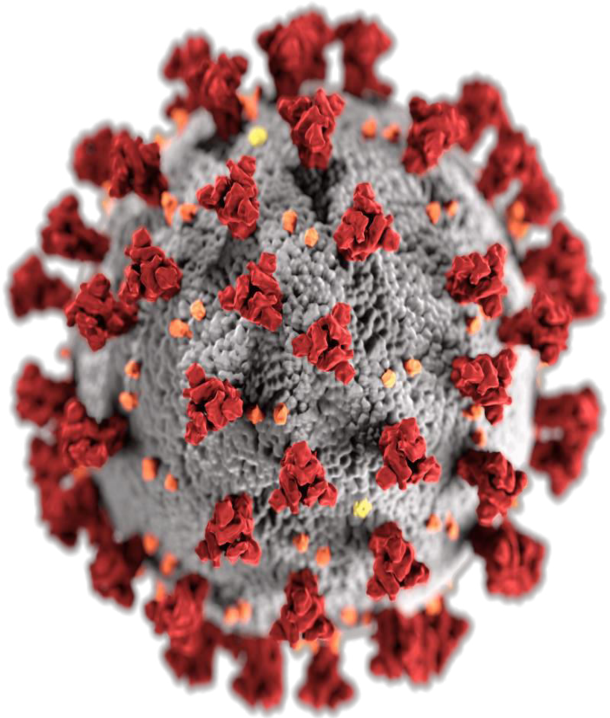
Welcome to my Class

Physics Ph1206

09:00 AM
April 27, 2021

COVID-19 Precautions



- Don’t be afraid
- Be aware of the pandemic
- Use appropriate outfits if you compelled to go out
- Try to maintain proper diet
- Do not forget to exercise (at least one hour) regularly
- Try to follow the guidelines of WHO and Bangladesh Government
- Try to stay at home

Khulna University if Engineering & Technology

Department of Physics

Physics Seasonal for the student of Mechanical Engineering

1^{st} Year, Term-2.

Course No. Phy-1206

Exp-0: To study some laboratory instruments and hence determination of instrumental errors and measurement of length mass and time.

Exp-1: To show the sensitivity of balance with load by drawing a graph

Exp-2: To determine the Young's modulus and modulus of rigidity of a short wire by Searle's dynamic method.

Exp-3: To determine the surface tension of water by capillary tube method.

Exp-4: To determine the specific heat of liquid by the method of cooling.

Exp-5: To determine the thermal conductivity of a bad conductor by Lee's and Charlton's method.

Exp-6: To determine the frequency of a tuning fork by Melde's experiment.

Exp-7: To determine the angle and the refractive index of the material of a prism by using a spectrometer.

Exp-8: To determine the wavelengths of various spectral lines by a spectrometer using discharge tube and a plane diffraction grating.

Exp-9: To determine the wavelength of a Sodium Light by measuring the diameter of Newton's rings.

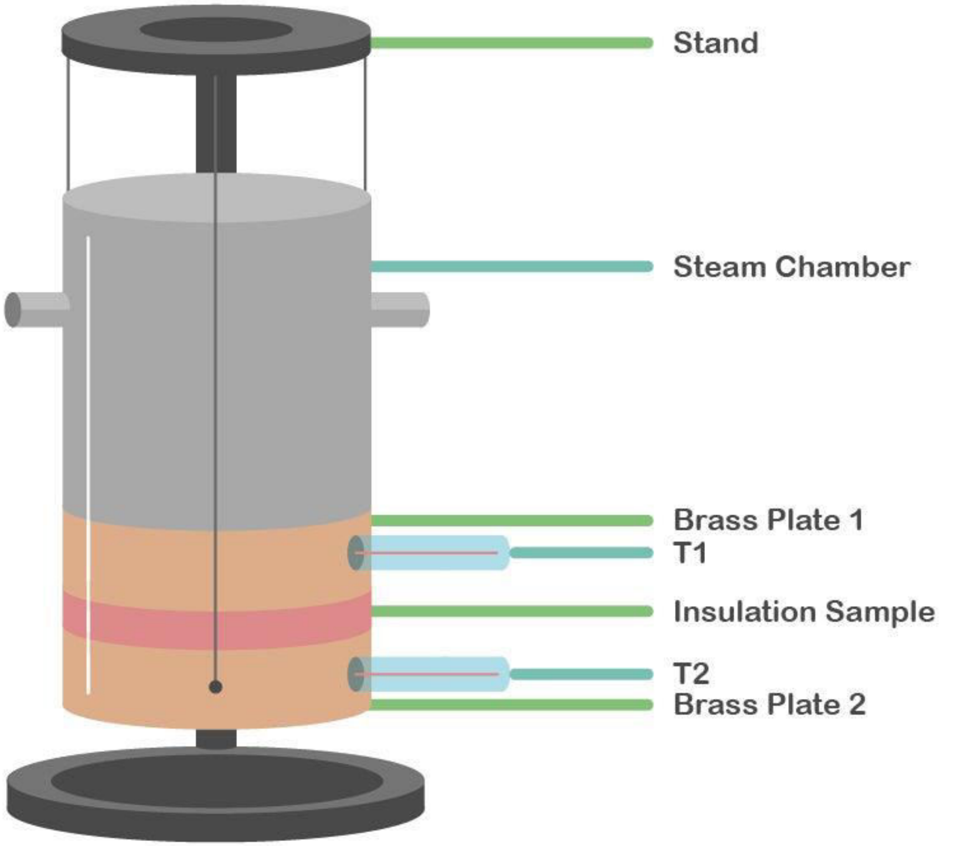
Exp-10: To determine the specific rotation of a sugar solution by using a polarimeter.

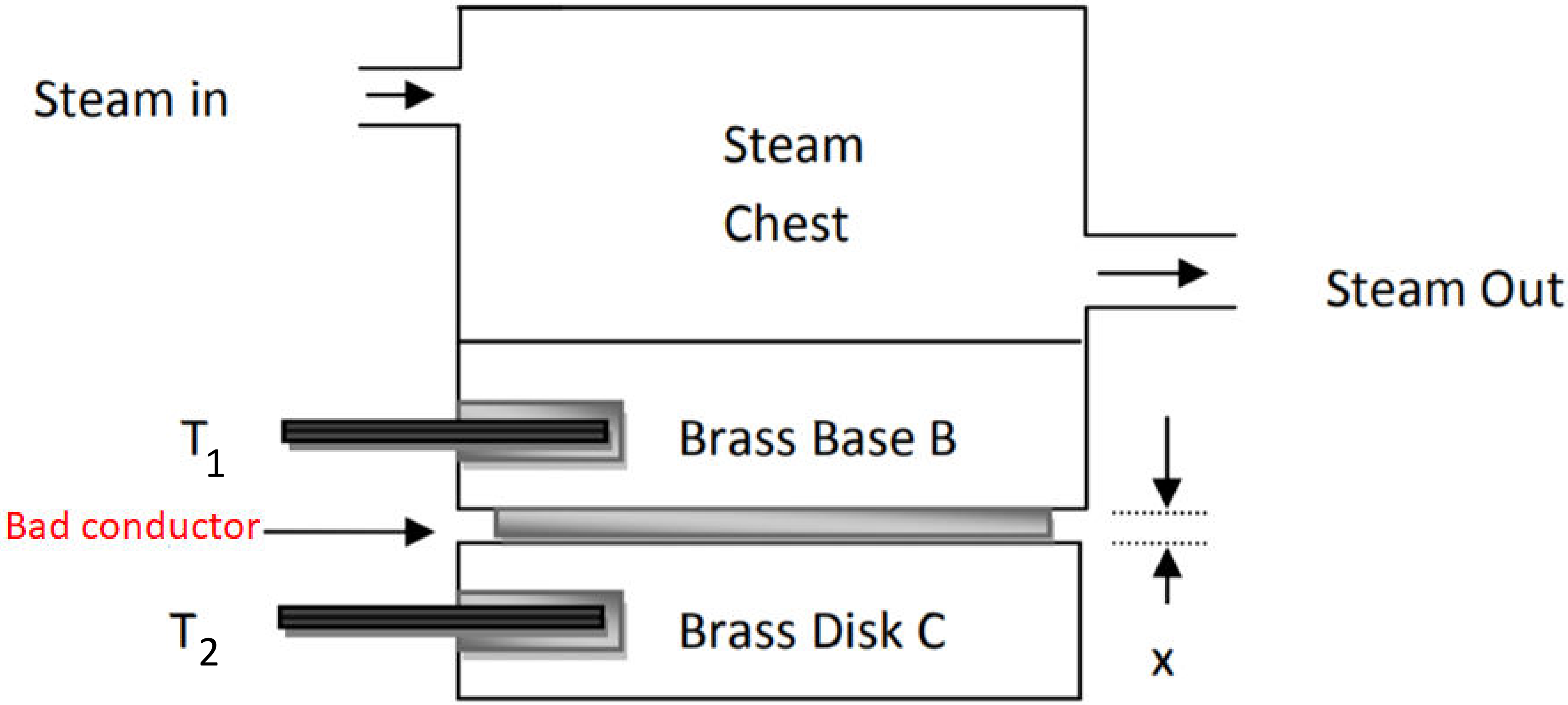
Exp-11: To determine the value of an unknown resistance and to verify the laws of series and parallel resistance by means of a Post Office box.

Exp-12: To find the value of Planck's constant and photoelectric work function of the material using a photo-electric cell.

Thermal Conductivity of a Bad Conductor

To determine the thermal conductivity of a bad conductor by Lee's and Charlton's Method





Steam in
Steam
Chest
Steam Out
T1
Brass Base B
Bad conductor
T2
Brass Disk C
x

Thermal Conductivity of a bad conductor

$$K = \frac{ms\left(\frac{dT}{dt}\right)x}{A(T_1 - T_2)}$$

Where,

m = Mass of the disc C

s = Specific heat of the disc C

$\frac{dT}{dt}$ = Rate of fall of temperature of disc C

x = Thickness of the bad conductor

A = Area of cross section of the bad conductor disc

T_1 & T_2 = Steady state temperature of discs B and C

Apparatus

Lee’s and Charlton’s apparatus

Circular disc of a bad conductor

Two thermometers

Slide Calipers

Screw gauge

Burner

Heater

Table A: Data for time temperature record of metal discs B and C

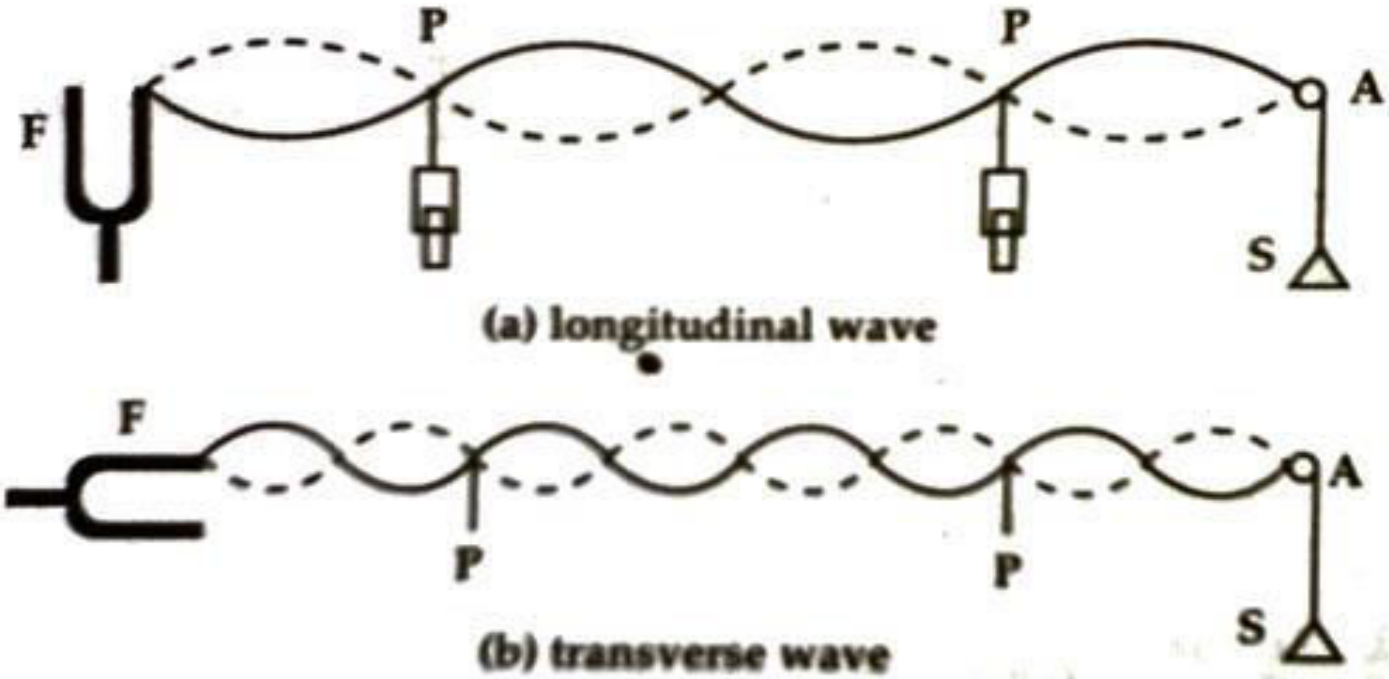
Time in minutes	0	5	10	15	20	25	30	etc.
T_1 (°C)								
T_2 (°C)								

Table A: Data for time temperature record of disc C during its cooling

Time in minutes	0	0.5	1.0	1.5	2.0	2.5	Etc.
Temperature in °C							

Melde's Experiment

To determine the frequency of a tuning fork by Melde's experiment



For Longitudinal position the frequency of the tuning fork

$$N = 2\sqrt{\frac{1}{4m}\left(\frac{T}{l^2}\right)}$$

For Transverse position the frequency of the tuning fork

$$N = \sqrt{\frac{1}{4m}\left(\frac{T}{l^2}\right)}$$

Where,

T = Tension of the thread

l= Length of each loop

m= Mass per unit length of the thread

Apparatus

- Tuning fork
- Thread
- A stand with clamp
- Pulley
- Ruler
- Weight box

Table A: Data for estimating frequency of the tuning fork at longitudinal position

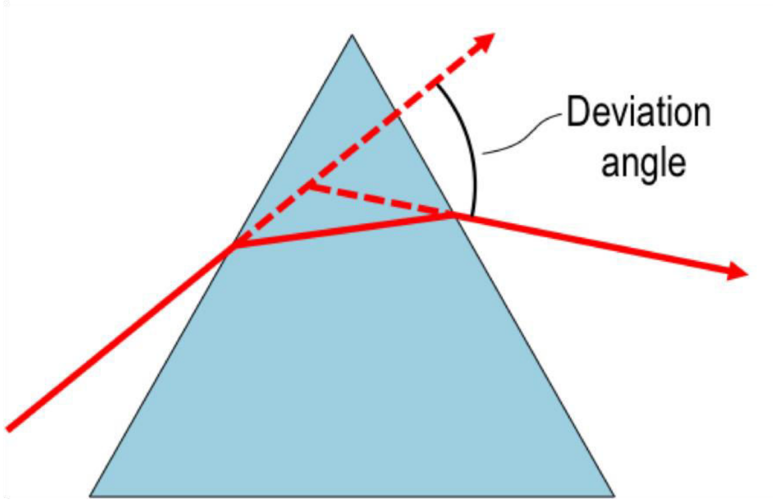
No. of obs.	Load on the scale pan	Tension T=(w+w')g	No. of loops p	Length of the thread L	Length of each loop l=L/p	T/l^2	Frequency of the string, n = $\sqrt{\frac{1}{4m}\left(\frac{T}{l^2}\right)}$	Frequency of the fork N=2n

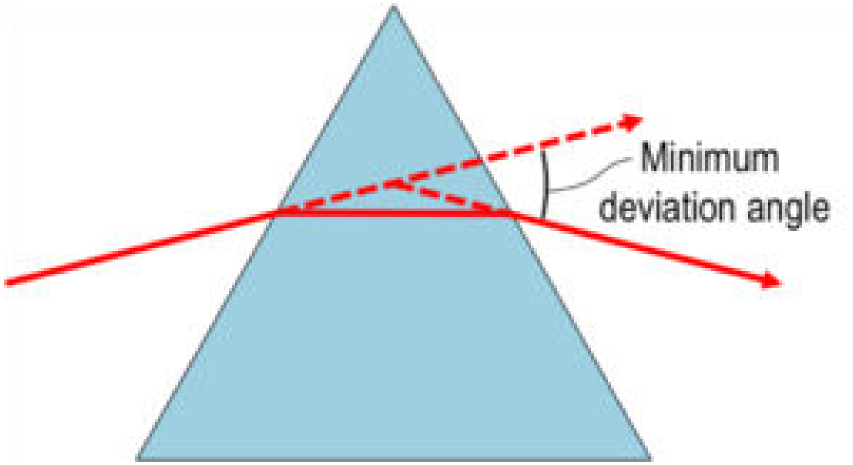
Table B: Data for estimating frequency of the tuning fork at transverse position

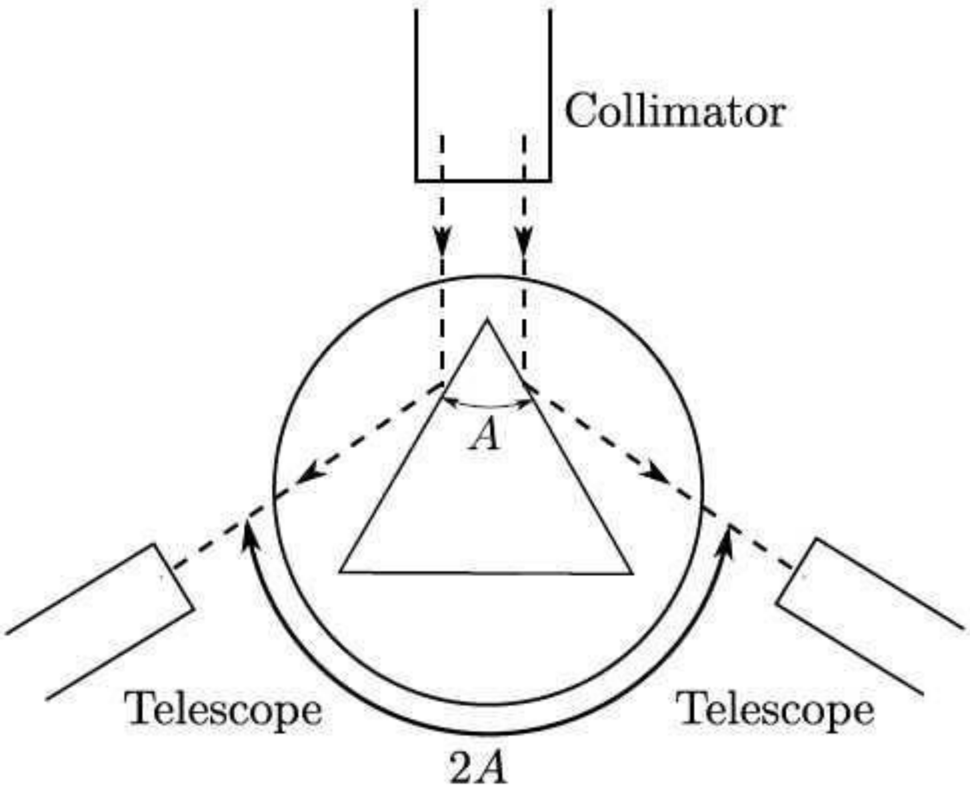
No. of obs.	Load on the scale pan	Tension $T=(w+w')g$	No. of loops p	Length of the thread L	Length of each loop $l=L/p$	T/l^2	Frequency of the string, $n = \sqrt{\frac{1}{4m}\left(\frac{T}{l^2}\right)}$	Frequency of the fork N=n

Angle of Prism

To determine the angle of a prism and the refractive index of the material of the prism by using a spectrometer







Collimator
A
Telescope
Telescope
2A

Refractive index of the material of a prism

$$\mu = \frac{\sin\frac{A+\delta_m}{2}}{\sin\frac{A}{2}}$$

Where,

A = Angle of the prism

δ_m= Angle of minimum deviation

Apparatus

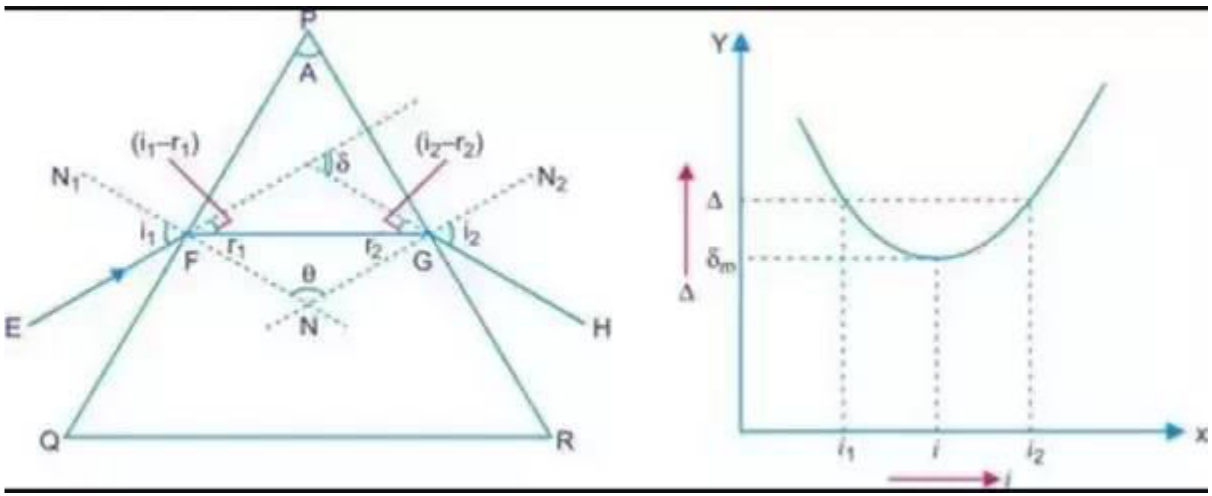
Spectrometer

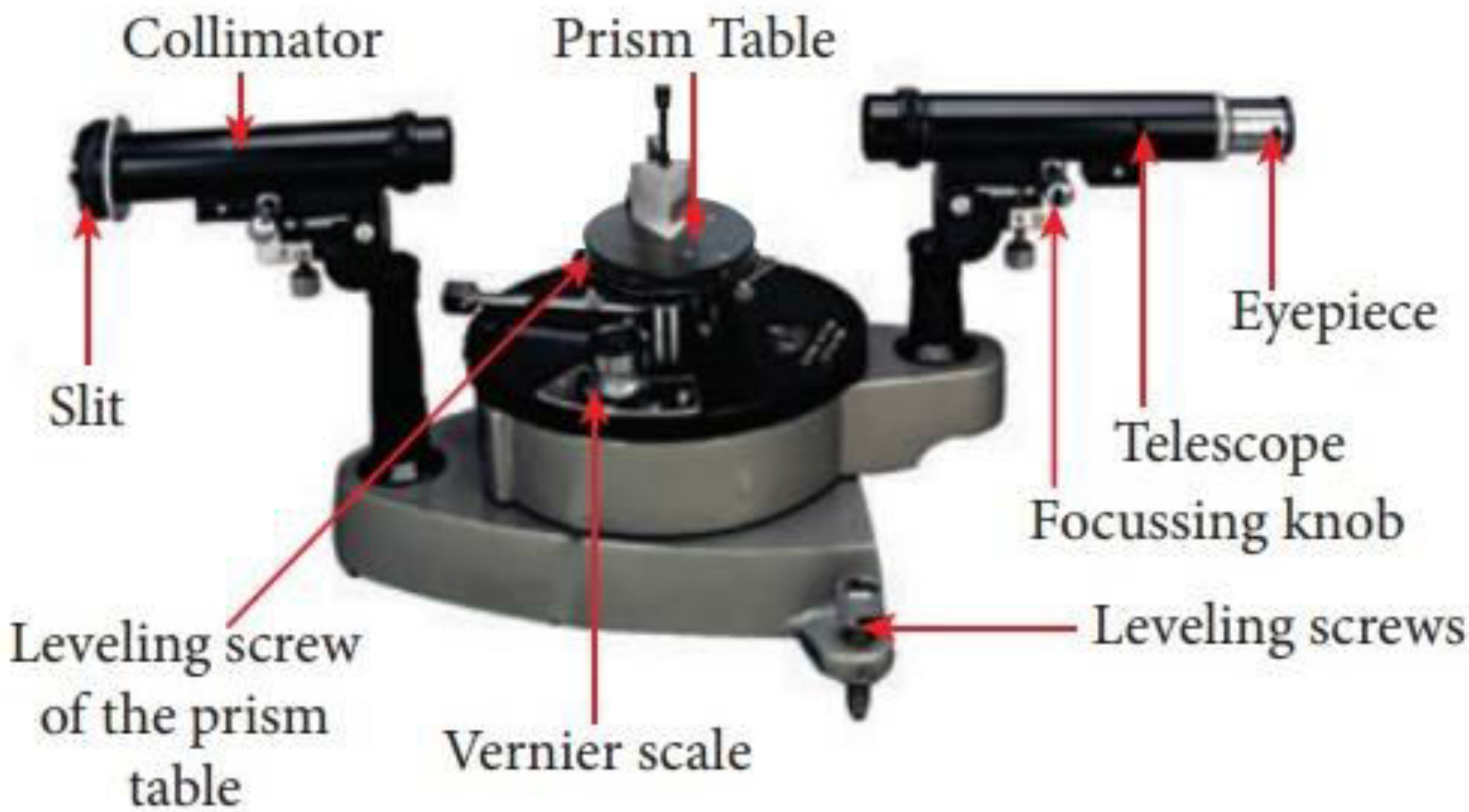
Sodium light

Prism

Sprit level

Magnifying glass


P
A
(i1–r1)
(i2–r2)
δ
N1
N2
i1
r1
r2
i2
F
G
θ
E
N
H
Q
R
Y
Δ
δm
Δ
i1
i
i2
X



Collimator
Prism Table
Eyepiece
Slit
Telescope
Focussing knob
Leveling screws
Leveling screw of the prism table
Vernier scale

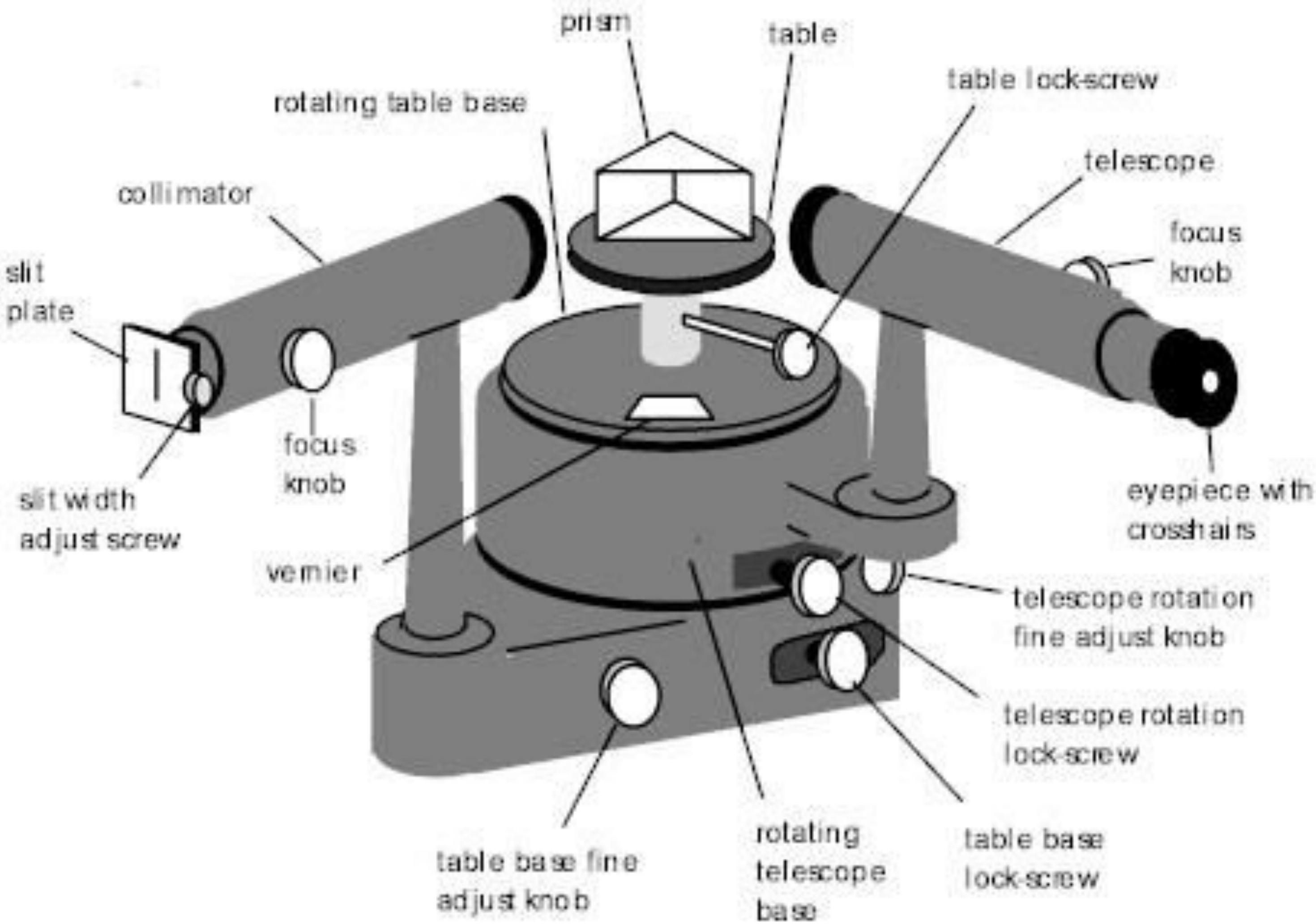

prism
table
table lock-screw
rotating table base
telescope
collimator
focus
knob
slit
plate
focus
knob
slit width
adjust screw
eyepiece with
crosshairs
vernier
telescope rotation
fine adjust knob
telescope rotation
lock-screw
table base fine
adjust knob
rotating
telescope
base
table base
lock-screw

Table A: Data for Angle of Prism

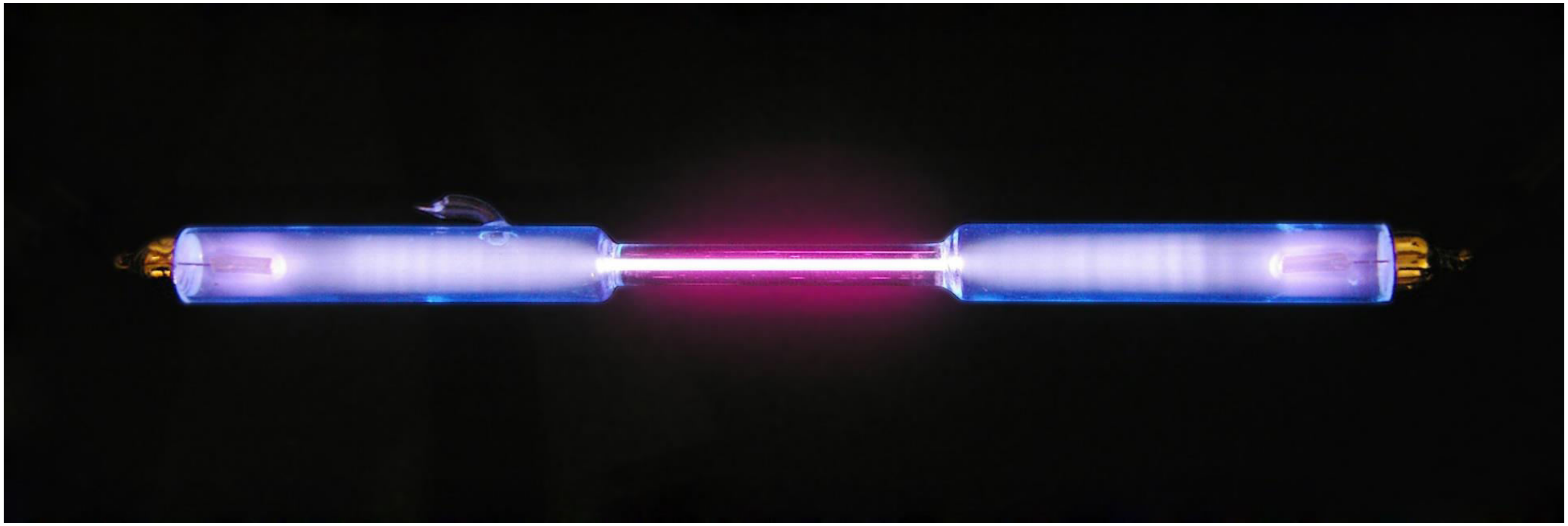
Vernier scale no.	No. of obs.	Reading for left image				Reading for right image				2A= M~N (Degree)	Mean A (Degree)
		MSR (Degree)	VD	VSR V= VDXVC (Degree)	M= S+V (Degree)	MSR (Degree)	VD	VSR V= VDXVC (Degree)	N= S+V (Degree)		
V_1	1										
	2										
	3										
V_2	1										
	2										
	3										

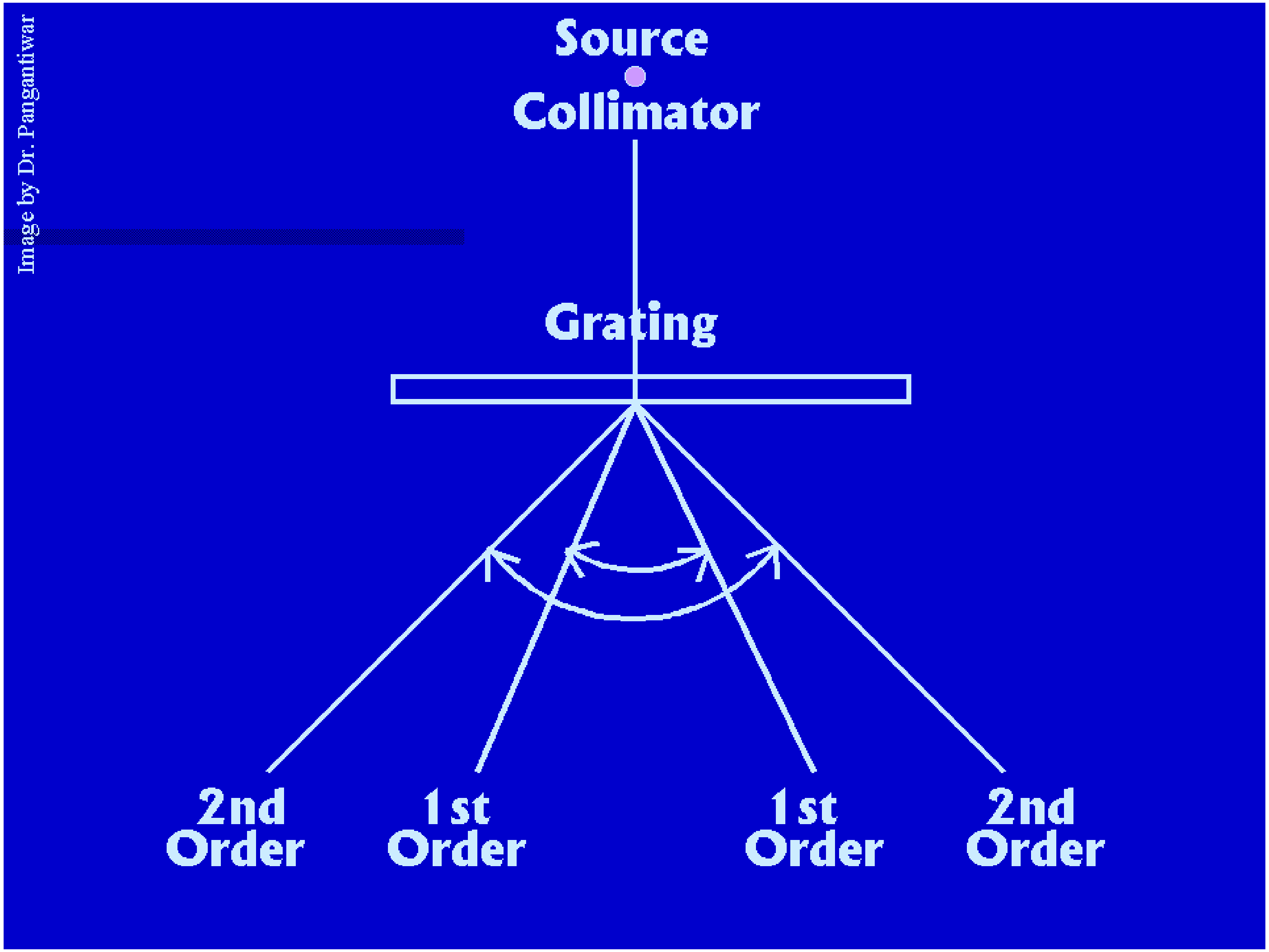
Table B: Data for minimum deviation

Vernier scale no.	No. of obs.	Reading for left/right image				Reading for direct image				Minimum deviation δ_m=M~N (Degree)
		MSR (Degree)	VD	VSR V= VDXVC (Degree)	M= S+V (Degree)	MSR (Degree)	VD	VSR V= VDXVC (Degree)	N= S+V (Degree)	
V_1	1									
	2									
	3									
V_2	1									
	2									
	3									

Discharge Tube

To determine the wavelengths of various spectral lines by a spectrometer using discharge tube and a plane diffraction grating





Source
Collimator
Grating
2nd Order
1st Order
1st Order
2nd Order
Image by Dr. Pangantiwar

$$\text{Wavelength of spectral line,} \quad \lambda = \frac{\sin\theta}{nN}$$

Where,

θ = Angle of diffraction

n = Order of Diffraction

N = Number of slits/lines per unit length of the grating

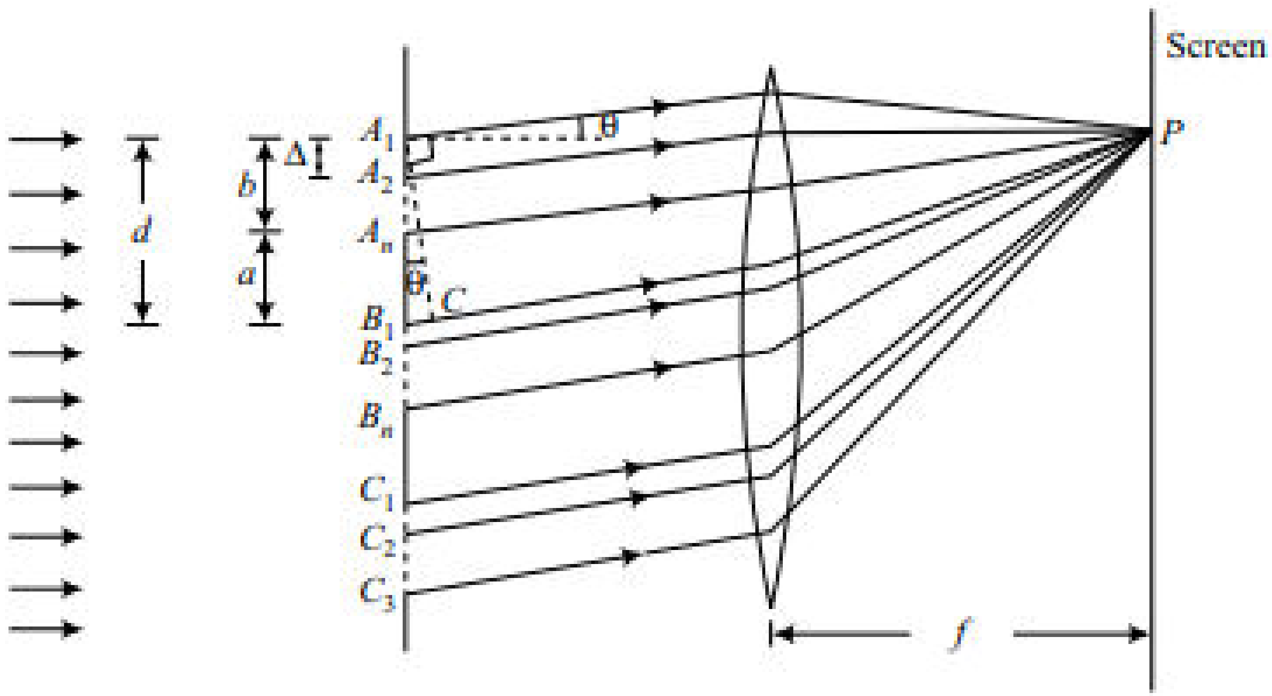
Apparatus

Spectrometer

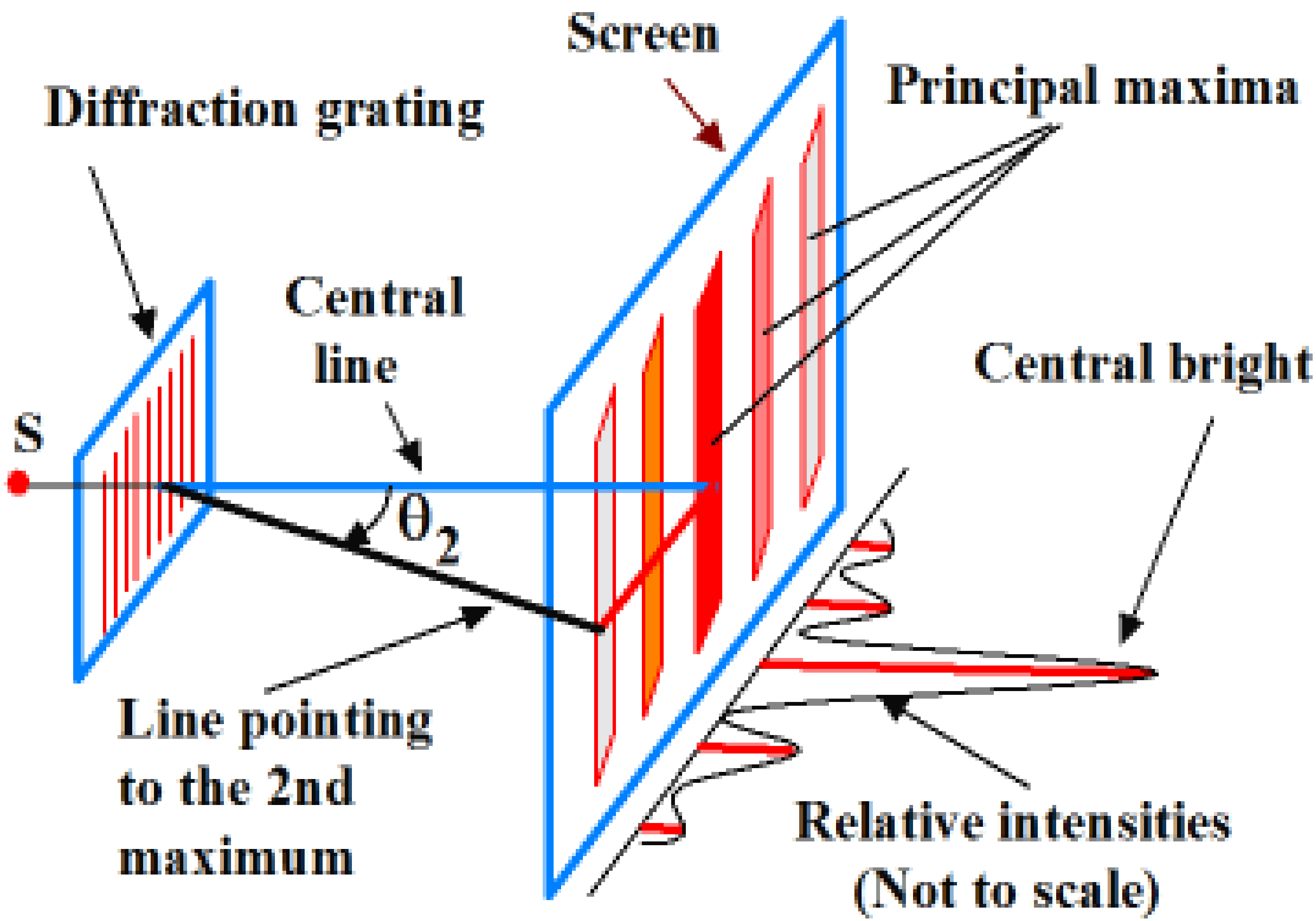
Spirit level

Magnifying glass

Diffraction grating with clamping arrangement



Screen
P
A_1
A_2
A_n
B_1
B_2
B_n
C_1
C_2
C_3
Δ
b
a
d
θ
C
f


Screen
Principal maxima
Diffraction grating
Central
line
Central bright
S
θ2
Line pointing
to the 2nd
maximum
Relative intensities
(Not to scale)

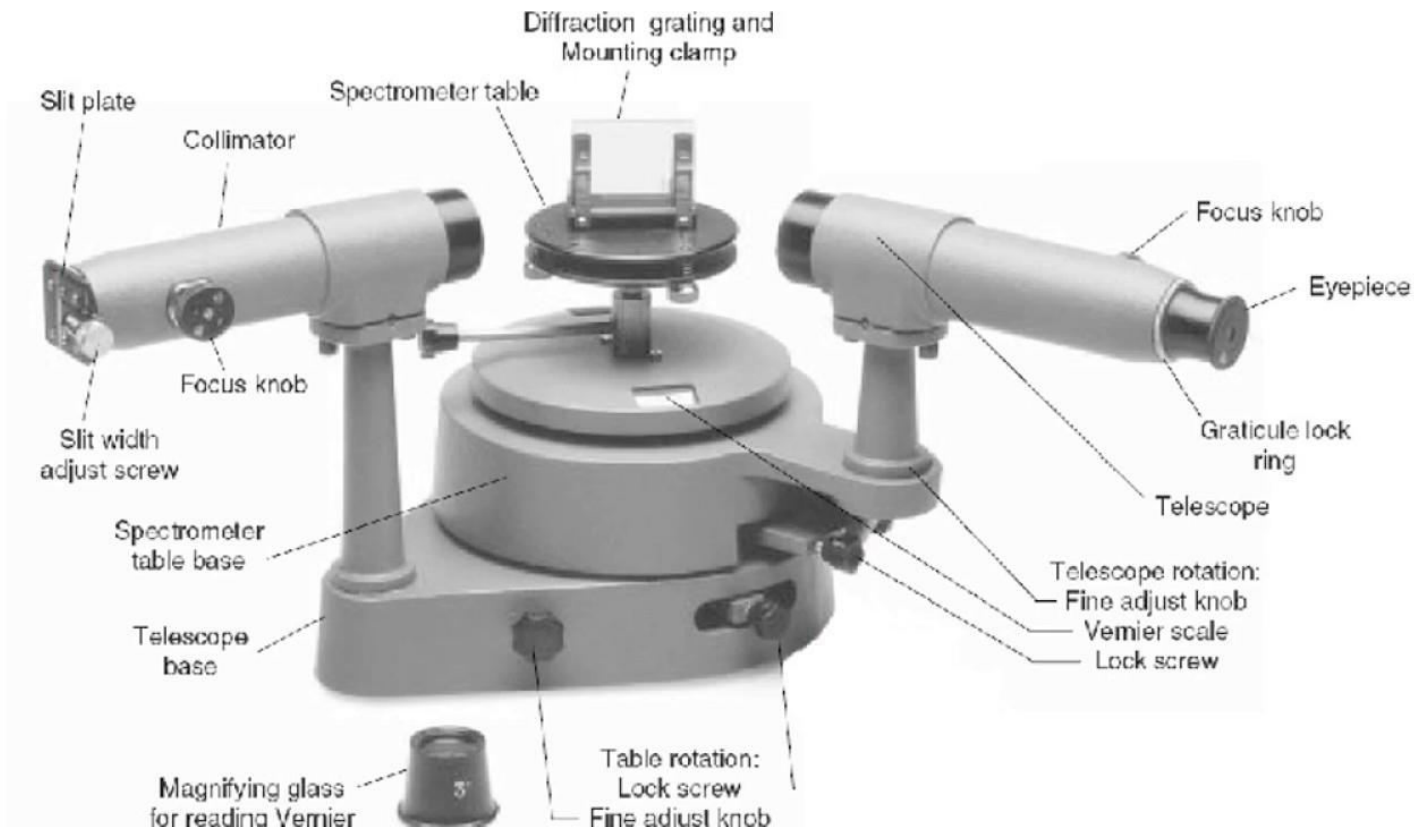
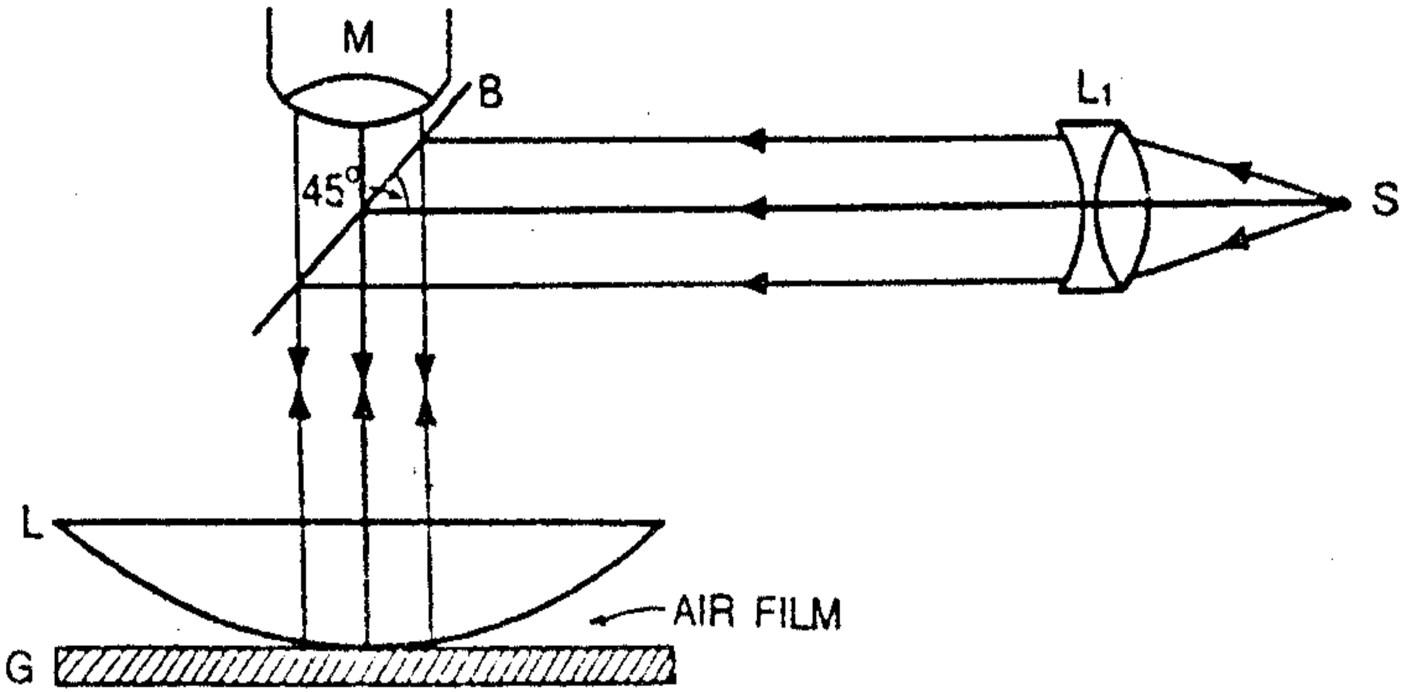

Diffraction grating and
Mounting clamp
Slit plate
Spectrometer table
Collimator
Focus knob
Eyepiece
Focus knob
Slit width
adjust screw
Graticule lock
ring
Telescope
Spectrometer
table base
Telescope rotation:
Fine adjust knob
Vernier scale
Lock screw
Telescope
base
Table rotation:
Lock screw
Fine adjust knob
Magnifying glass
for reading Vernier

Table A: Data for angle of diffraction for different spectral lines

Order of spectrum	Color of the spectrum	Reading for the left image				Reading for the right image				2θ = M~N (degree)	θ (degree)	λ (A)
		MSR S (degree)	VD	VSR V= VDXVC (degree)	Total N=S+V (degree)	MSR S (degree)	VD	VSR V= VDXVC (degree)	Total N= S+V (degree)			
1st order												
2nd order												

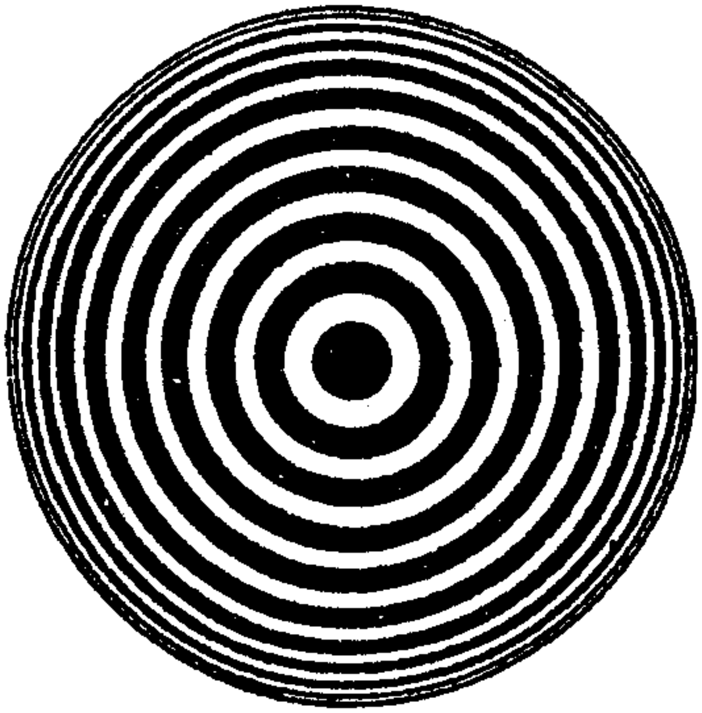
Newton's Rings

To determine the wave length of sodium light by measuring the diameters of Newton's rings



Wavelength of light

$$\lambda = \frac{D_m^2 - D_n^2}{4(m-n)R}$$



Where,

D_m = Diameter of mth ring

D_n = Diameter of nth ring

R= Radius of curvature of the lower surface of plano-convex lens

Apparatus

Newton's ring apparatus consisting of plane glass plate inclined at an angle 45^o and a convex lens

A travelling microscope

Sodium lamp

Table A: Data for diameters of Newton's Rings

Ring No.	Left side reading			Right side reading			Diameter of the rings D=L~R (cm)	D^2 (cm^2)
	MSR S (cm)	VSR V= VDXVC (cm)	Total L=S+V (cm)	MSR S (cm)	VSR V= VDXVC (cm)	Total R=S+V (cm)		
1								
2								
3								
…								
…								
15								

Specific Rotation

To determine the specific rotation of sugar solution by using a polarimeter

Specific rotation at temperature t and wavelength of light λ

$$S_{\lambda}^{t} = \frac{10\theta}{lc}$$

Where,

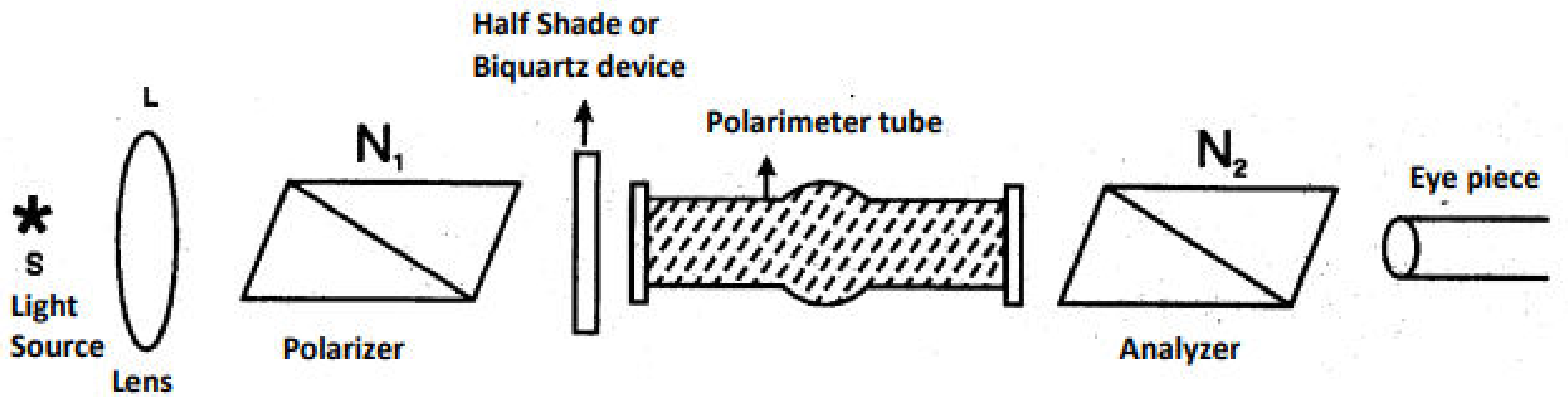
θ = Angle of rotation

l = Length of the tube

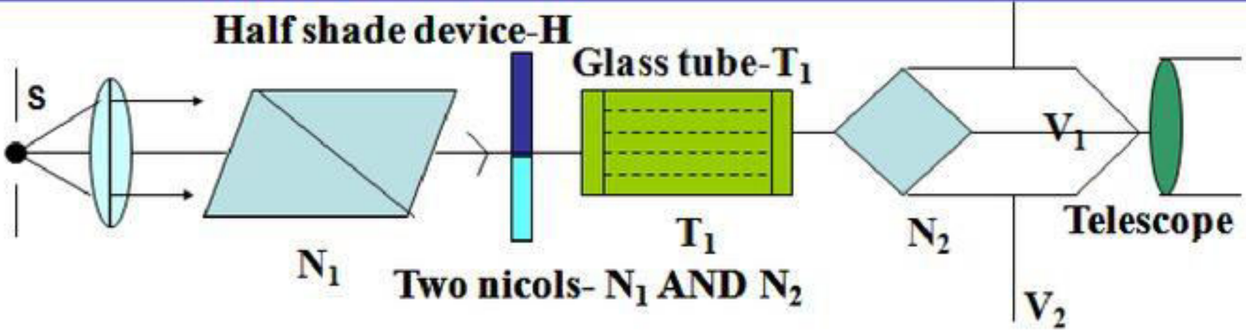
c = Concentration of solution

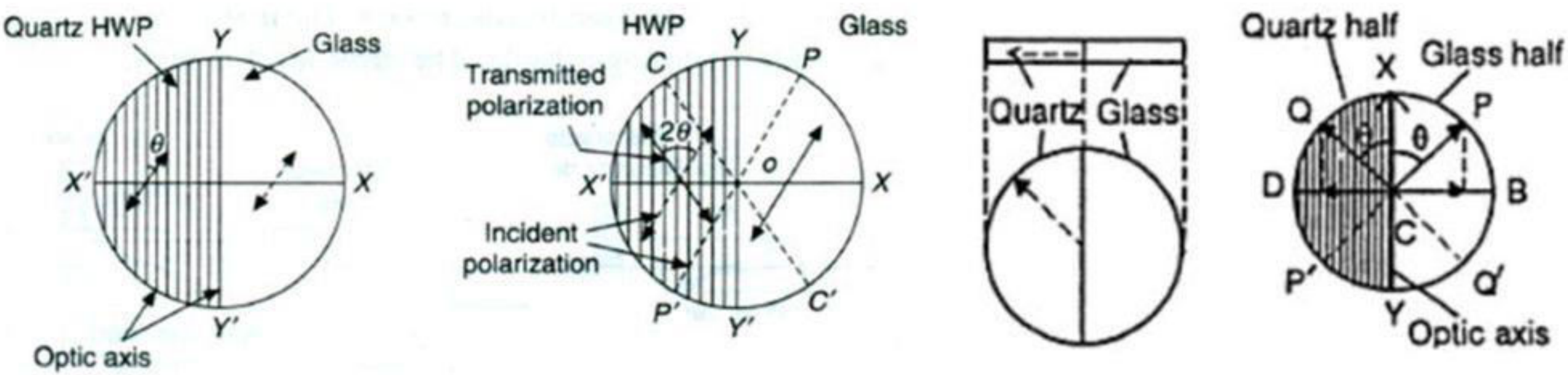
Apparatus

- Polarimeter
- Sodium lamp
- Sugar
- Clean water
- Graduated cylinder
- Two beakers
- Filter paper
- Pipette
- Glass rod


Half Shade or
Biquartz device
L
Polarimeter tube
N1
N2
Eye piece
S
Light
Source
Lens
Polarizer
Analyzer

Laurent's Half shade polarimeter





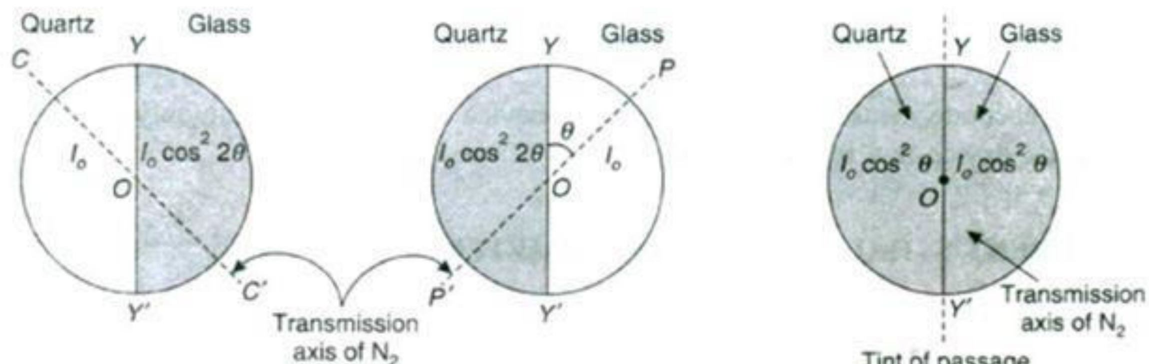
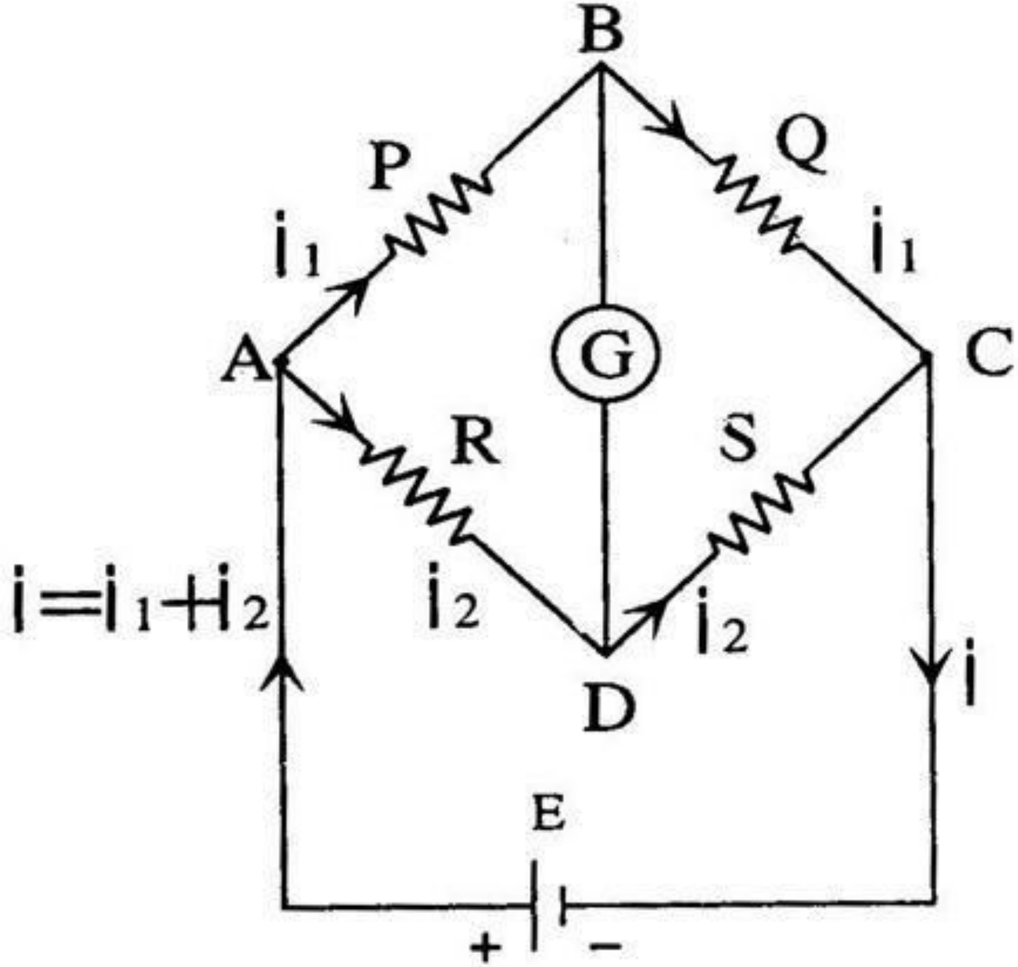


Table A: Data for angle of rotation

Strength of sugar solution	No. of obs.	First reading with water (P) (Degree)	Second reading with solution (Q) (Degree)	Angular rotation (Q~P) (Degree)	Mean angular rotation (Degree)	Specific rotation (degree.cm^3 /dm/gm)
	1					
	2					
	3					

Post Office Box

To determine the value of an unknown resistance and to verify the laws of series and parallel resistances by means of a post office box


B
P
Q
i1
i1
A
G
C
R
S
i=i1+i2
i2
i2
i
D
E
+
−

Unknown Resistance

$$S = R\left(\frac{Q}{P}\right)$$

Equivalent series resistance

$$R_s = R_1 + R_2$$

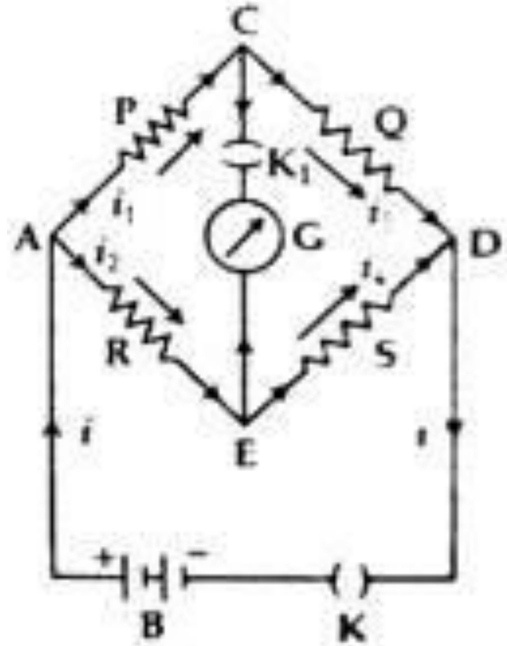
Equivalent parallel resistance R_p

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

Where, R_1 and R_2 are unknown resistances

Apparatus

- Post office box
- Unknown resistances
- Galvanometer
- Battery cell
- Commutater
- Key
- Connecting wires


C
P
Q
K_1
A
G
D
R
S
E
B
K

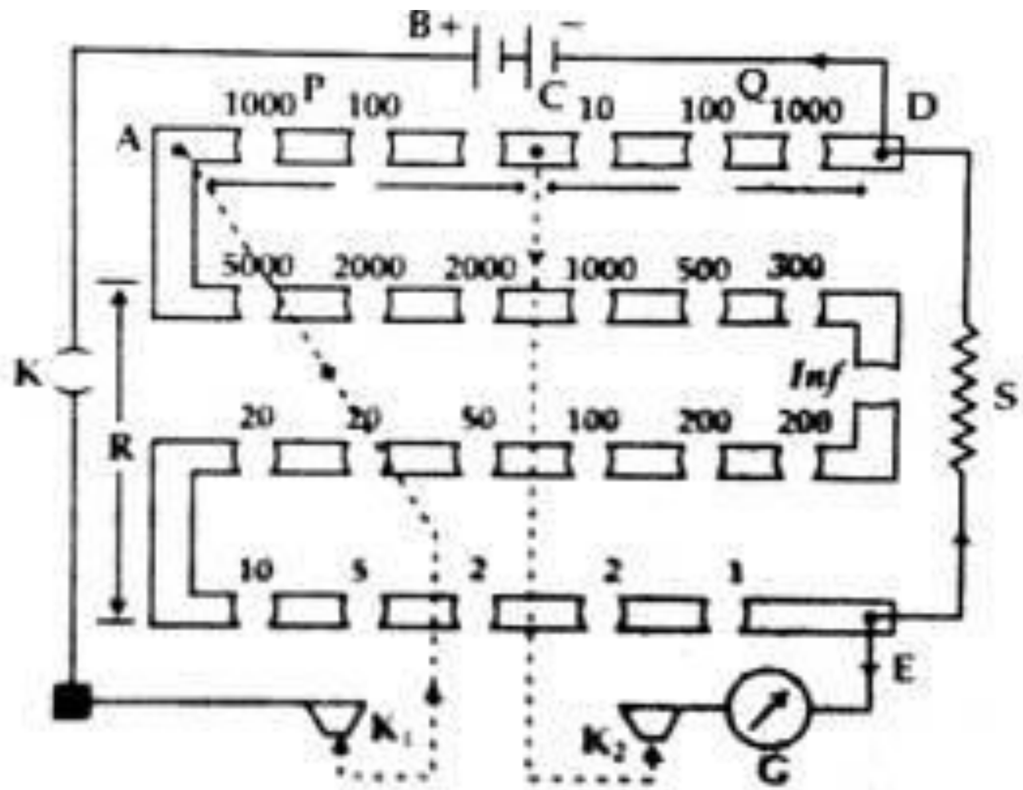
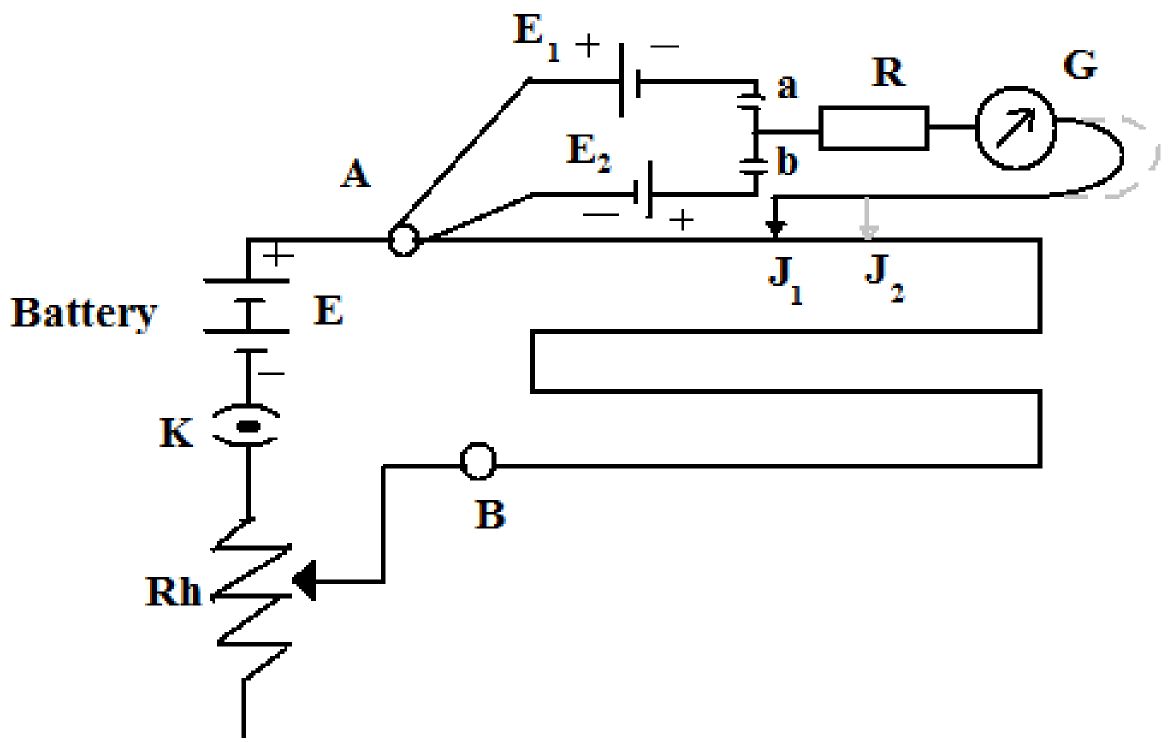

B +
−
1000 P 100
C 10
100 Q 1000
D
A
5000 2000 2000 1000 500 300
K
R
Inf
S
20 20 50 100 200 200
10 5 2 2 1
E
K_1
K_2
G

Table A: Data for unknown resistance R_1

Resistance (Ω)			Direction of deflection	Inference for the third arm resistance
P	Q	R		
10	10	0 ∞		
100	10			
1000	10			

Potentiometer

To compare the EMF of two cells with the help of a potentiometer



Comparison of EMFs

$$\frac{E_1}{E_2} = \frac{l_1}{l_2}$$

Where,

l_1 = Balancing length for cell E_1

l_2 = Balancing length for cell E_2

Apparatus

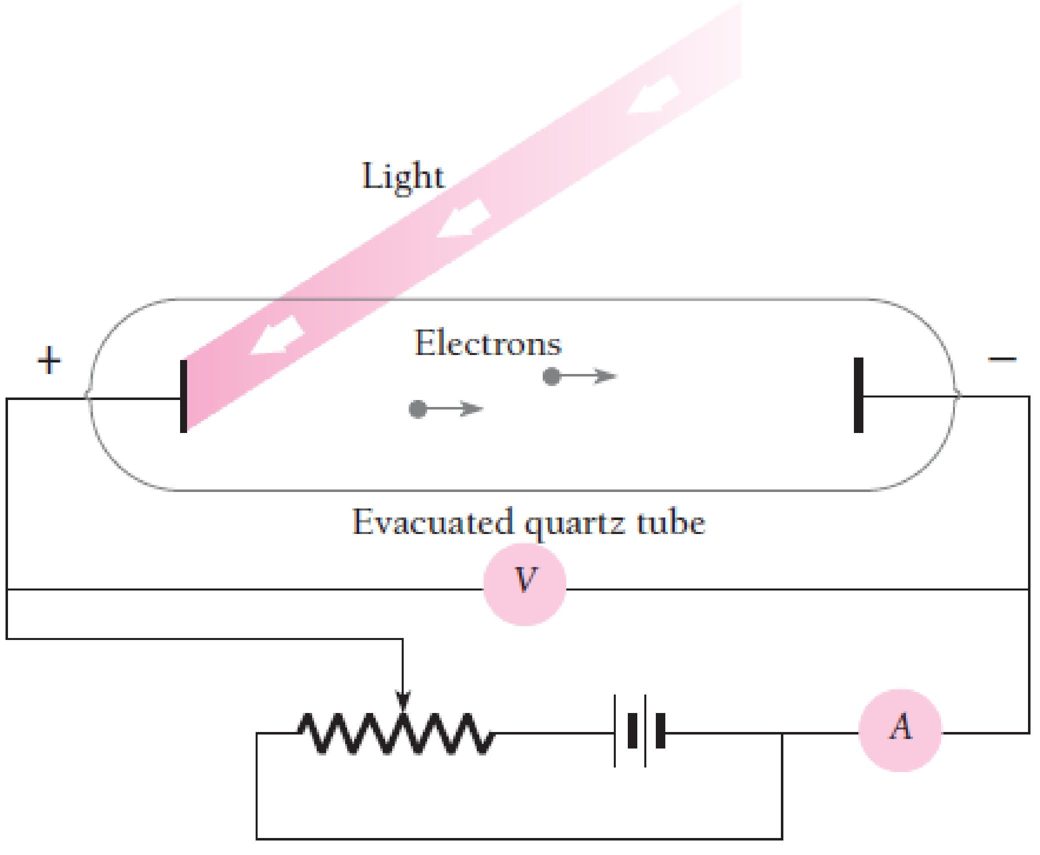
- Potentiometer
- Storage cell
- Two cells for comparison
- High resistance
- Rheostat
- Galvanometer
- A three way key
- Connecting wires

Table A: Data for comparison of EMFs

No. Of Obs.	Cell No.	Null Point		Total length (cm)	$E_1/E_2 = l_1/l_2$	Mean E_1/E_2
		Wire number	Scale reading (cm)			
1	First (E_1)	10th				
	Second (E_2)					
2	First (E_1)	9th				
	Second (E_2)					
3	First (E_1)	8th				
	Second (E_2)					
4	First (E_1)	7th				
	Second (E_2)					
5	First (E_1)	6th				
	Second (E_2)					
6	First (E_1)	5th				
	Second (E_2)					

Photoelectric Effect

To find the value of Planck's constant and work function of the material using a photoelectric cell



Planck's constant

$$h = \frac{eV_o}{(\upsilon - \upsilon_o)}$$

Work function

$$w = h\upsilon_o$$

Where,

e = Charge of an electron

V_o= Stopping potential

υ= Frequency of light

υ_o= Threshold frequency

Apparatus

Variable potential

Photocell

Ammeter

Voltmeter

Frequency filter

Table A: Data for maximum stopping potential

Sl. No.	Frequency of light, ν (Hz)	Stopping potential V_o (Volt)	Maximum kinetic energy, eV_o (J)


I Thank you