Simple Pendulum (البندول البسيط)

Room No: 1A42

Objective: To determine the acceleration due to gravity (g) by the Simple Pendulum.

Formula Used:

For small amplitudes the period of a simple pendulum depends only on its length and the value of the acceleration due to gravity

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

Where

T – Time period
L – Length of thread
g – Acceleration due to gravity

Making Square

$$T^2 = \frac{4\pi^2}{g}.L$$

Compare with y = m x we get Slope = $\frac{4\pi^2}{g}$

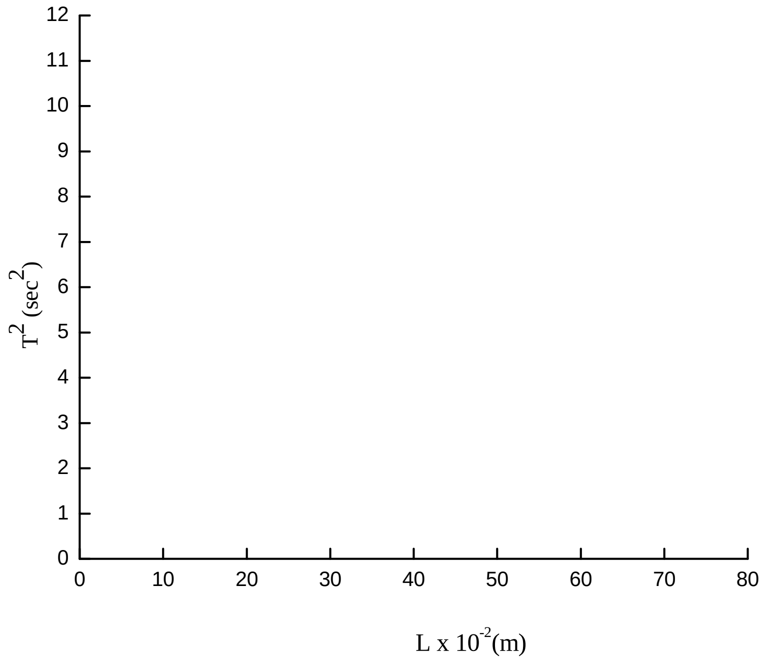
So, $$\boxed{g = \frac{4\pi^2}{Slope}}$$

Observation table

L x 10^{-2} (m) **X-axis**	**t_1(sec) for 10 Osc.**	**t_2 (Sec) for 10 Osc.**	**t_3 (Sec) for 10 Osc.**	**$\bar{t}$ (Sec)**	**T = $\frac{\bar{t}}{10}$ (Sec)**	**T^2 (sec^2) Y-axis**
40						
50						
60						
70						
80						

Graph

X-axis: 1cm=10 (m)
Y-axis: 1cm=1 (sec^2)



$$Slope = \frac{(y_2 - y_1)}{(x_2 - x_1)\times 10^{-2}} = \ldots\ldots\ldots$$

Result

So, the experimental value of g will be

$$g' = \frac{4\pi^2}{Slope} = \frac{4\pi^2}{.......} = \ldots\ldots..\ (m/s^2)$$

g = 9.8 (m/s^2) Theoretical value

Percentage Error

$$\%\ error\ = \frac{|g - g'|}{g} \times 100 = \frac{|9.8 - ....|}{9.8}\ \text{x}\ 100 = ...\%$$

Planck's constant (ثابت بلانك)

Room No: 1A44

Objective: To determine the value of Planck's constant (h).

Formula Used:

Total energy of photons

$$E = K.E. + W_0$$
$$h\,f = eV_s + W_0$$

Cut off voltage/Stopping voltage

$$\boxed{V_s = \frac{h}{e}.f - \frac{W_0}{e}}$$

Where
f = c/λ = frequency of light (Hz) or sec^{-1}
c – Speed of light = 3 x 10^{8} m/s
e – Charge of electron = 1.6 x 10^{-19} C
λ – Wavelength of different light

Compare with $y = m\,x + c$

Slope = h/e

So, $\boxed{h = e \times Slope}$

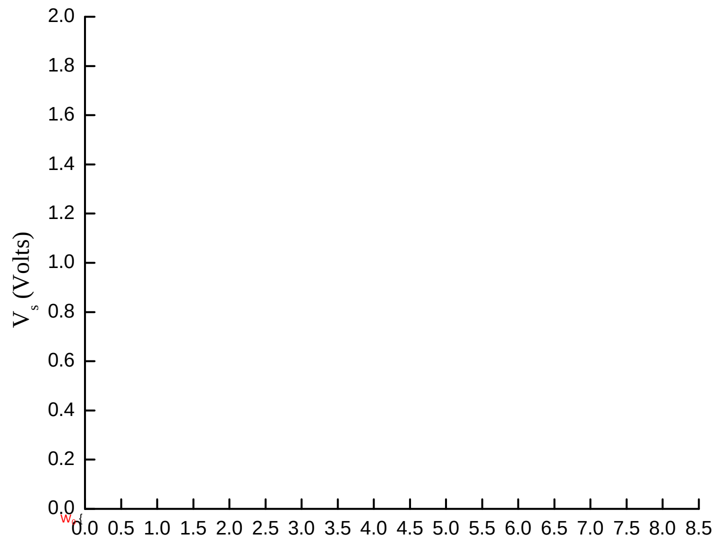
Observation table

Color	**λ x 10^{-9} (m)**	$f = (c/\text{ª})\times 10^{14}$ **(Hz)** **X-axis**	**Vs (V) (n=1)**	**Vs (V) (n=2)**	$\overline{V_s}$ **(Volts)** **Y-axis**
Yellow	578.00				
Green	546.07				
Blue	435.84				
Purple1	404.66				
Purple2	365.48				

Note:
(1) Use dark room.
(2) Use filters only for Yellow and Green light.
(3) Put the multimeter at 2V DC & switch on the h/e apparatus.

Graph

X-axis: 1cm=0.5 x 10^{14} (Hz)
Y-axis: 1cm=0.2 (Volts)



$$f = \frac{c}{a}(Hz)\times 10^{14}$$

$$Slope = \frac{(y_2 - y_1)}{(x_2 - x_1)\times 10^{14}} = (.........)\text{x}10^{-14}$$

Result

Experimental value of Planck's constant

$$h' = e \times Slope = 1.6\text{ x }10^{-19}\text{ x } .... = ...(J.s)$$

Theoretical value of Planck's constant (h) is **6.626 x 10^{-34} J.s**

Percentage Error

$$\%\ error\ = \frac{|h - h'|}{h}\times 100 = \frac{|6.626 - ....|}{6.626}\times 100 = ...\%$$

Ohm's Law (قانون أوم)

Room No:1A45

Objective: To verify the Ohm's law for series and parallel connections.

1. Ohm's Law

[For R_1=2 Ω]

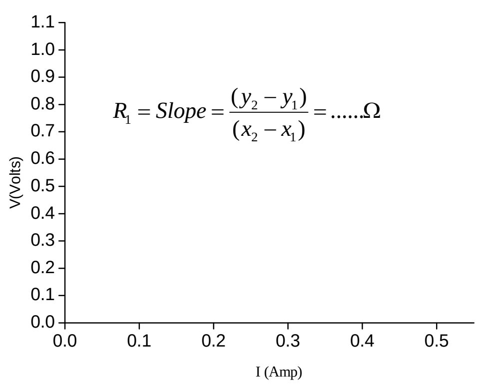
I (Amp) x-axis	**V (Volts)** y-axis	**R_1= V/I (Ω)**
0.1		
0.2		
0.3		
0.4		
0.5		

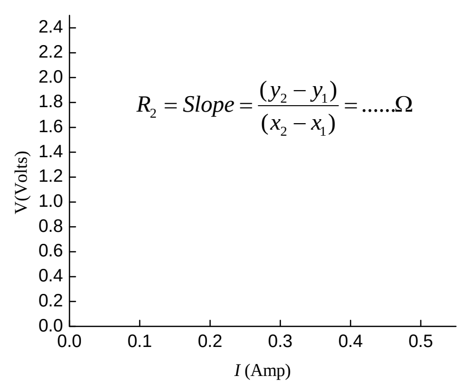
[For R_2=5 Ω]

I (Amp) x-axis	**V (Volts)** y-axis	**R_2= V/I (Ω)**
0.1		
0.2		
0.3		
0.4		
0.5		

$$\overline{R_1} = \frac{\sum R_1}{5} = \frac{\text{..........}}{5} = \text{..........}\ \Omega$$

$$\overline{R_2} = \frac{\sum R_2}{5} = \frac{\text{.........}}{5} = \text{.........}\ \Omega$$





Note: Plot graph only for this section.

2. Resistance in series connection

I (Amp)	V (Volts)	R_S= V/I (Ω)
0.1		
0.2		
0.3		

From experiment $\overline{R_S} = \dfrac{\sum R_S}{3} = ... \Omega$

In series connection $R_S = R_1 + R_2 = ... + ... = ... \Omega$

3. Resistance in parallel connection

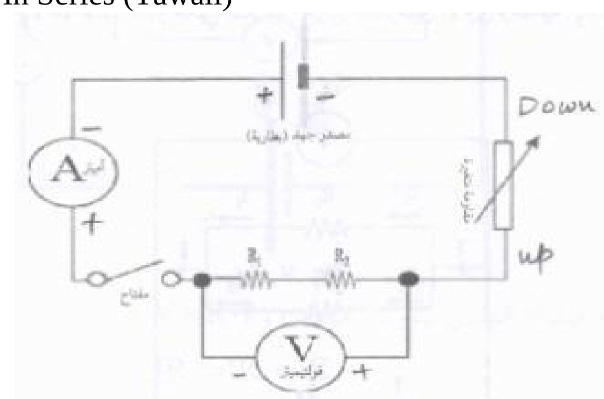
I (Amp)	V (Volts)	R_p= V/I (Ω)
0.1		
0.2		
0.3		

From experiment $\overline{R_p} = \dfrac{\sum R_p}{3} = ... \Omega$

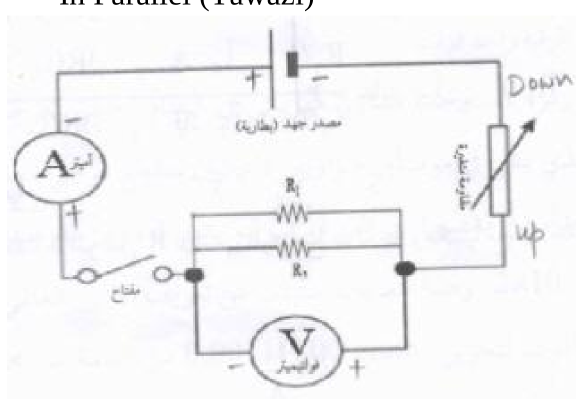
In parallel connection $R_p = \dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{...........}{...........} = ... \Omega$

Circuit Diagrams

In Series (Tawali)



In Parallel (Tawazi)



Result: Ohm's law verified.

Absorption Coefficient of γ- rays (معامل الامتصاص)

Room No:1A46

Objective: To determine the absorption coefficient of γ- rays (μ).

Formula Used:

When a gamma ray passes through matter, the probability for absorption is proportional to the thickness of the layer, the density of the material, and the absorption cross section of the material. The total absorption shows an exponential decrease of intensity with distance from the incident surface:

$$I_c = I_{o\,c}\, e^{-«x}$$

$$\ln\left(\frac{I_{oc}}{I_c}\right) = «\, x$$

Compare with $y = m\,x$

$$\boxed{« = Slope}$$

where, x is the distance from the incident surface
μ = *n*σ is the absorption coefficient, measured in cm^{-1}

Steps

(1) Background intensity [Put the Al sheet in the 2nd last row]

$$\overline{I_{BG}} = \frac{I_{BG1} + I_{BG2} + I_{BG3}}{3} = \frac{...+...+....}{3} = ...(C/\min)$$

(2) Original intensity [Put Pb source in the last row]

$$\overline{I_o} = \frac{I_{o1} + I_{o2} + I_{o3}}{3} = \frac{......+.....+.....}{3} = ...(C/\min)$$

Source intensity without background

$$I_{oc} = \overline{I_o} - \overline{I_{BG}} = ...-...... = ...(C/\min)$$

(3) Put Cobalt black slice 2 at a time above the Pb & Al sheet and note down I_1, I_2 & I_3 for observation table.

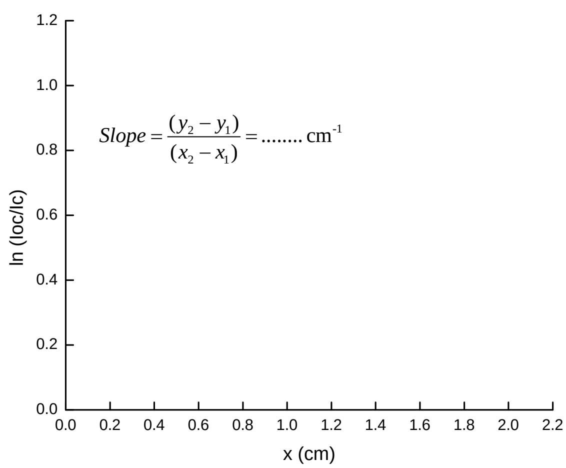
Observation table

No of Slice	***x* (cm)** **X- axis**	**I_1 (C/min)**	**I_2 (C/min)**	**I_3 (C/min)**	**$\bar{I}$ (C/min)**	$I_c = \bar{I} - I_{BG}$	$\frac{I_{oc}}{I_c}$	$\ln\left({I_{oc}}/{I_c} \right)$ **Y-axis**
2	0.4							
4	0.8							
6	1.2							
8	1.6							
10	2.0							

Note:
(1) Set the Time 60 Sec.
(2) H.V. = 500 V
(3) Press H.V.
(4) Press count.
(5) Each Cobalt sheet has a thickness 0.2 cm.

Graph

X-axis: 1cm=0.2 (cm)
Y-axis: 1cm=0.2



Result

Apply this formula for absorption coefficient of Gamma-rays:

« $= Slope = ... (cm^{-1})$

Note: Press H.V. down to zero then switch off the machine. Don't switch off directly.

Capacitors (المكثفات)

Room No: 1B8

Objective: To determine the time constant (t) by charging of a capacitor.

Formula Used:

Equation for charging of a capacitor

$$V = V_0(1 - e^{-t/RC})$$

where

t – Time constant
R – Resistance = 1 MΩ
C – Capacitance = 100 μF

When t = RC

$$V = V_0(1 - e^{-1})$$

$$\boxed{V = 0.63\,V_0}$$

The theoretical value of time constant

t = RC = 1 MΩ x 100 μF = 1 x $\cancel{10}^6$ x 100 x $\cancel{10}^{-6}$ = **100 Sec**

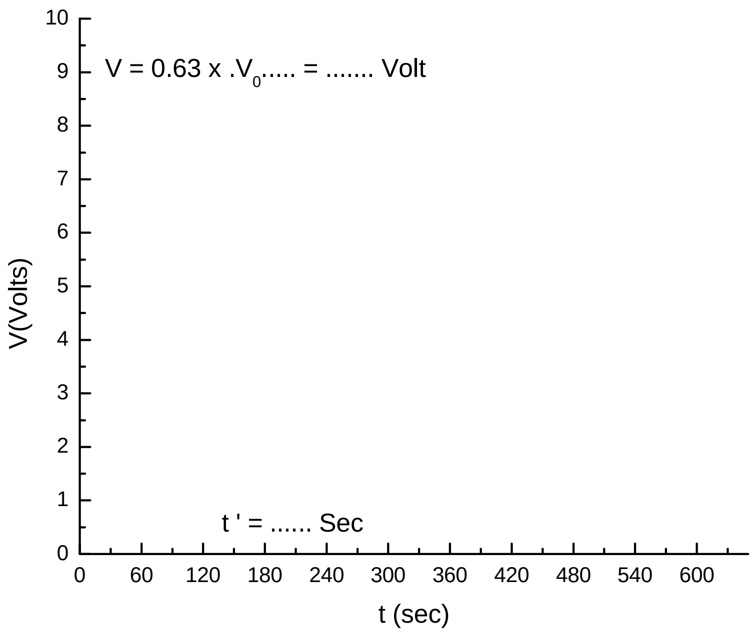
Observation table

t (Sec) **x-axis**	**V (Volts)** **y_1-axis (Graph-1)**	$\ln\left(\frac{V_0}{V_0 - V}\right)$ **y_2-axis (Graph-2)**
0		
30		
60		
90		
120		
150		
180		
210		

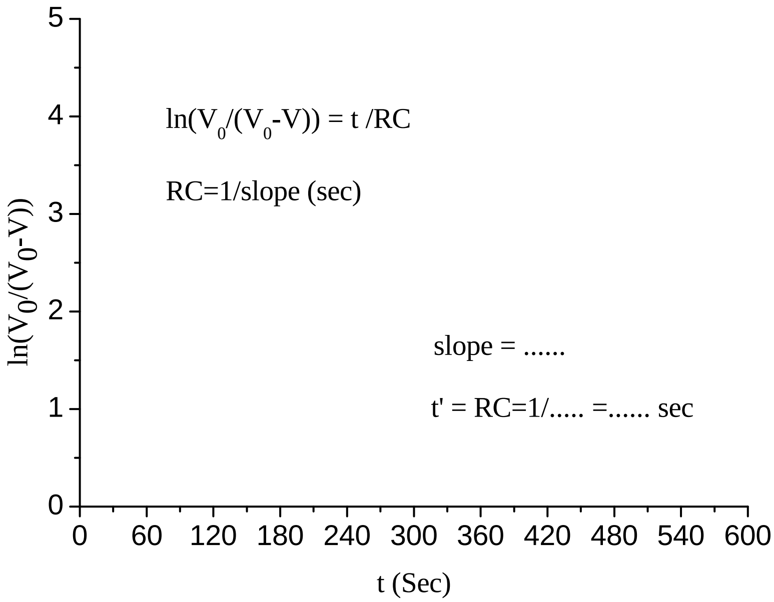
240		
270		
300		
330		
360		
390		
420		
450		
480		
510		
540		
570		
600	….. = V_0	

Graph

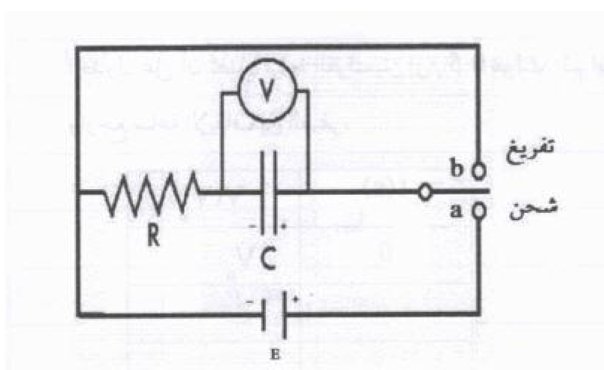
X-axis: 1cm=60 (sec)
Y-axis: 1cm=1 (Volts)



X-axis: 1cm=60 (sec)
Y-axis: 1cm=1



Circuit diagram



Note:

(1) First discharge the capacitor, if showing any voltage.
(2) Switch on green button & Voltmeter power button simultaneously (without stopping note down the *t* and V).
(3) Put on the voltmeter dc at 10 V.
(4) For Y_1-axis, divide the Multi-meter voltage by 10.

Result: We have found the time constant (t') = ……Sec for graph1 & (t') = ……Sec for graph2.

Prism (موشور)

Room No: 1B1

Objective: To determine the refractive index (n) of a given prism.

Formula Used:

The refractive index (n) of a prism is described as

$$n = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

Where,

A = angle of prism (60°)

D_m = minima of angle of deviation

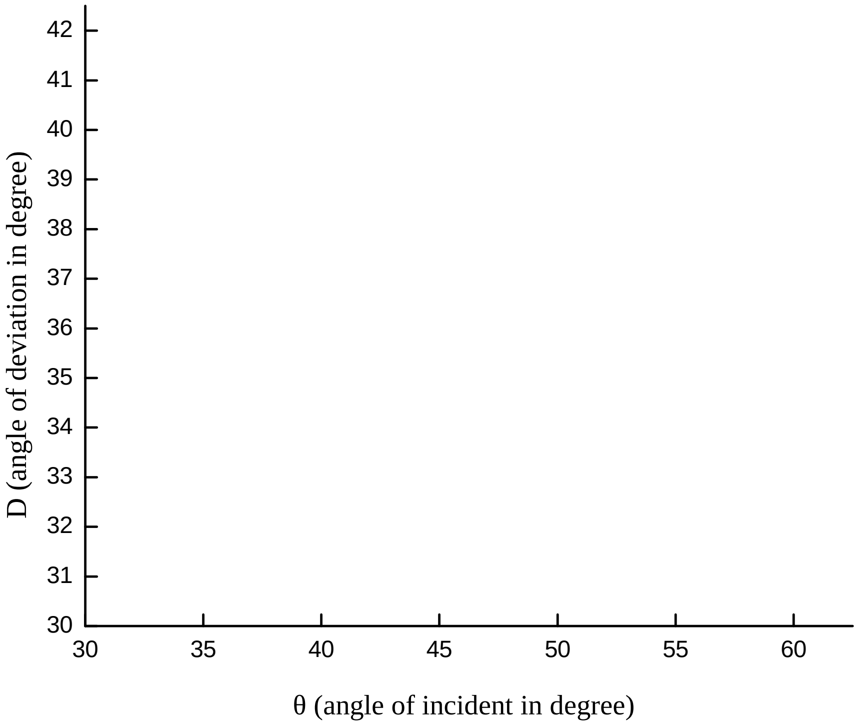
Observation table

θ (angle of incident in degree) x-axis	**D (angle of deviation in degree) y-axis**
35	
40	
45	
50	
55	
60	

Measuring θ & D (in plain paper 6 times)

Graph

X-axis: 1cm= 5 (degree)
Y-axis: 1cm= 1 (degree)



Result

The refractive index (n) of a prism is found to be

$$n = \frac{\sin\left(\frac{A+D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{60+......}{2}\right)}{\sin\left(\frac{60}{2}\right)} = ...$$

Potentiometer (Muqarinah) PHY-104

Room No: 1B20

Objective: To compare the e.m.f. of potentiometer.

Formula Used:

In the balance position

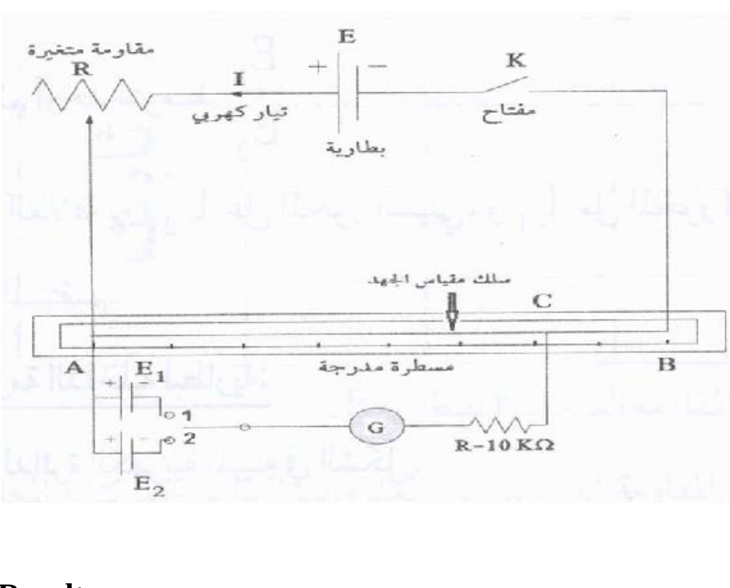
$$\frac{E_1}{E_2} = \frac{L_1}{L_2}$$

where, E_1– emf of first cell
E_2– emf of second cell
L_1 – Length upto null point (when key is on right side)
L_2 – Second length upto null point (when key is on left side)

Observation table

S. No.	**L_1 (cm)**	**L_2 (cm)**	$\frac{E_1}{E_2} = \frac{L_1}{L_2}$	Avg of E_1/E_2
1				
2				
3				
4				
5				

Circuit diagram



Result

The average value of E_1/E_2 is ………...

Meter-bridge (Qantarah) PHY-104

Room No: 1B18

Objective: To determine the resistivity of wire (ρ) by meter-bridge.

Formula Used:

In the balance position

$$\frac{R_w}{L_1} = \frac{R_B}{L_2}$$

$$R_w = \frac{R_B\, L_1}{L_2}$$

where,

R_w – Resistance of unknown wire
R_B – Resistance of resistance box
L_1 – Length from C to D
L_2 – Length from D to A

Observation table

R_B (Ω)	**L_1 (cm)**	**L_2 (cm) (100-L_1)**	$R_w = \frac{R_B\, L_1}{L_2}$ (Ω)	Avg of R_w
1				
2				
3				
4				
5				

Resistance of wire can be defined as

$$R_w = \circ\ \frac{L}{A}$$

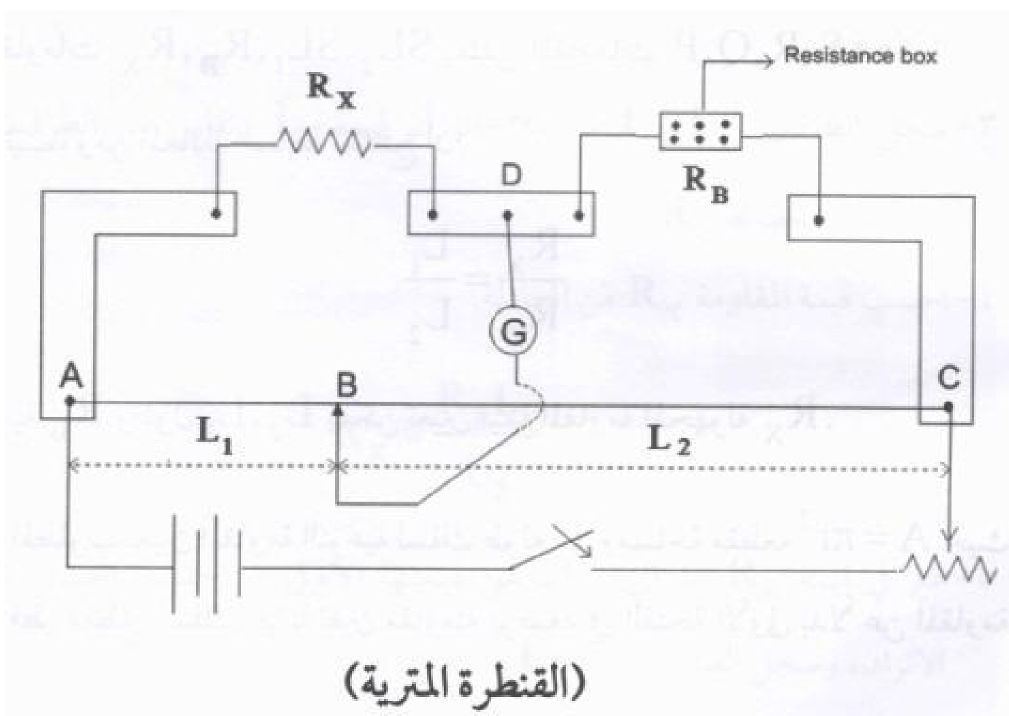
So, the resistivity of wire

$$^{\circ} = R_w \frac{A}{L}$$

Let L = length of wire = …… m
Radius of wire r = d/2 = 0.7/2 mm = **0.35×10^{-3} m**

Then Cross-section Area of wire A= $\pi r^2 = (3.14)(0.35 \times 10^{-3})^2$ = **0.38465×10^{-6} m^2**

Circuit Diagram



Result

Therefore, resistivity of unknown wire (substitute all the values)

$$^{\circ} = R_w \frac{A}{L} = ...(\Omega \, . \, m)$$

Lens (العدسات)

Room No: 1B16

Objective: To determine the focal length and power of given lens.

Formula Used:

$$\frac{1}{f}=\frac{1}{S}+\frac{1}{S'} \Rightarrow f=\left(\frac{S.S'}{S+S'}\right)(cm)$$

$$P=\frac{1}{f(m)}=\frac{100}{f(cm)}$$

Method Used

(1)

S(Object) = ∞, S'(Image) = f = $x_2 - x_1$ = ……– ……… = …… cm

$$P=\frac{100}{f}=\frac{100}{.....}=......\,cm^{-1}$$

(2)

S(Object) = f => S'(Image) = ∞ => S"= f= $x_2 - x_1$ =…….– ……. = …… cm

$$P=\frac{100}{f}=\frac{100}{.....}=.....\,cm^{-1}$$

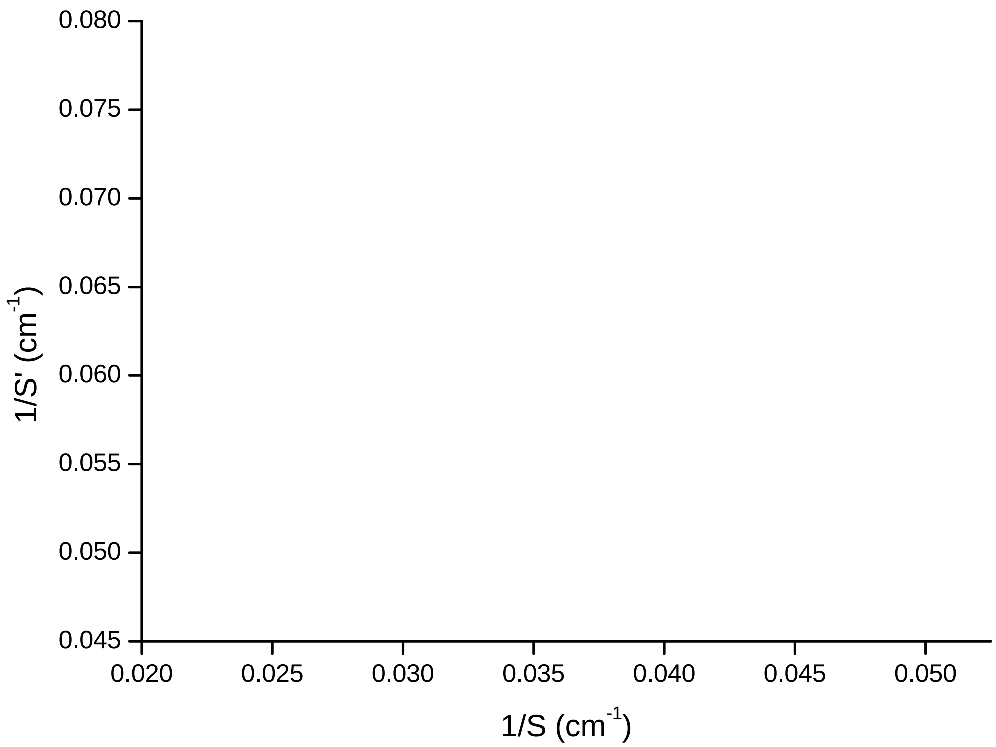
(3) Shift lens 5 cm each time (S) and S' will also shift.

Observation table

S (cm)	**S' (cm)**	**1/S (cm^{-1})** **x-axis**	**1/S' (cm^{-1})** **y-axis**	$f=\left(\frac{S.S'}{S+S'}\right)(cm)$	$\overline{f}(cm)$
20					
25					
30					
35					
40					

Graph

X-axis: 1cm=0.005 (cm^{-1})
Y-axis: 1cm=0.005 (cm^{-1})



$$f = \frac{2}{x+y} = \frac{2}{\ldots\ldots\ldots + \ldots\ldots\ldots\ldots} = \ldots\ldots\ldots\, cm$$

$$P = \frac{100}{f} = \frac{100}{\ldots\ldots\ldots} = \ldots\ldots\ldots\, cm^{-1}$$

Result

P (cm^{-1})	**f (cm)**	**Methods**
		(1)
		(2)
		(3)

Rydberg Constant (PHY-104)

Room No: 1B14

Objective: To determine the Rydberg constant (R_H).

Formula Used:

Rydberg's formula is given by

$$\frac{1}{a} = R_H \left(\frac{1}{p^2} - \frac{1}{n^2} \right)$$

where

p – Quantum number associated with the initial stage.
n – Quantum number associated with the final stage.
λ = *a*. sin β = Wavelength of series

For $p = 2$

$$\frac{1}{a} = R_H \left(\frac{1}{2^2} - \frac{1}{n^2} \right)$$

So, $$\boxed{R_H = \frac{1}{a} \left(\frac{4n^2}{n^2 - 4} \right)}$$

Observation table

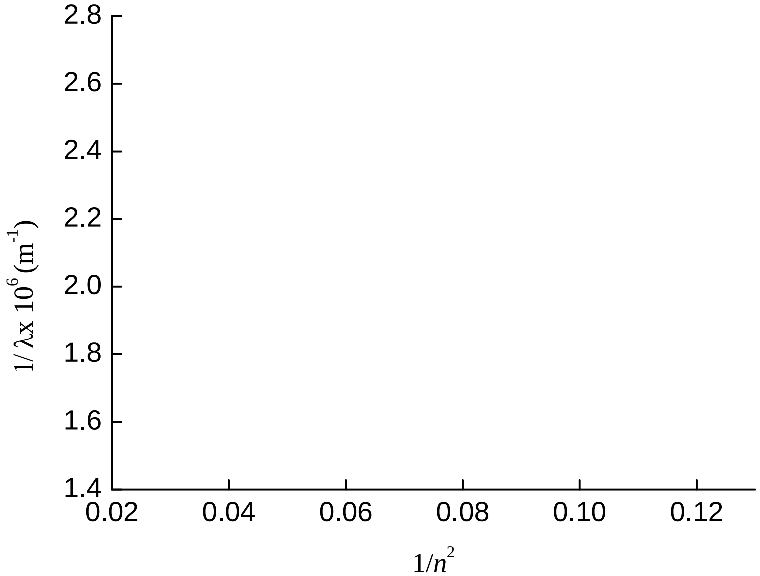
Colour	***n***	**$1/n^2$ (x-axis)**	***d*=D/2 (cm)**	$= \tan^{-1}\left(d/f_3 \right)$	$a = a \sin$	**1/ λ x 10^6 (y-axis)**
Red	3	0.11				
Blue	4	0.0625				
Voilet	5	0.04				

1 mm = 600 lines
1 m = 6 x 10^5 lines
f_3 = 10 (cm) = last lens near to the screen

$$a = \frac{1}{6\,x\,10^5} = 1.67\,x\,10^{-6}(m)$$

Graph

X-axis: 1cm=0.02
Y-axis: 1cm=0.2 (m^{-1})



$$Slope = \frac{(y_2 - y_1)\times 10^6}{(x_2 - x_1)} = -(\ldots\ldots\ldots\ldots)$$

Result

So, the experimental value of R'_H will be

$R'_H = -$ Slope $= -(-\ldots\ldots\ldots\ldots) = \ldots\ldots\ldots\ldots$ (m^{-1})

Percentage Error

R_H = **1.0974 x 10^7 m^{-1}** (theoretical value of Rydberg constant)

$$\%\ error = \frac{|R_H - R_H'|}{R_H}\times 100 = \frac{|1.0974 - \ldots\ldots|}{1.0974} \text{ x } 100 = \ldots\ldots\%$$