Somaiya Vidyavihar University
K. J. Somaiya College of Engineering, Mumbai -77
(A Constituent College of Somaiya Vidyavihar University)

Department of Science and Humanities

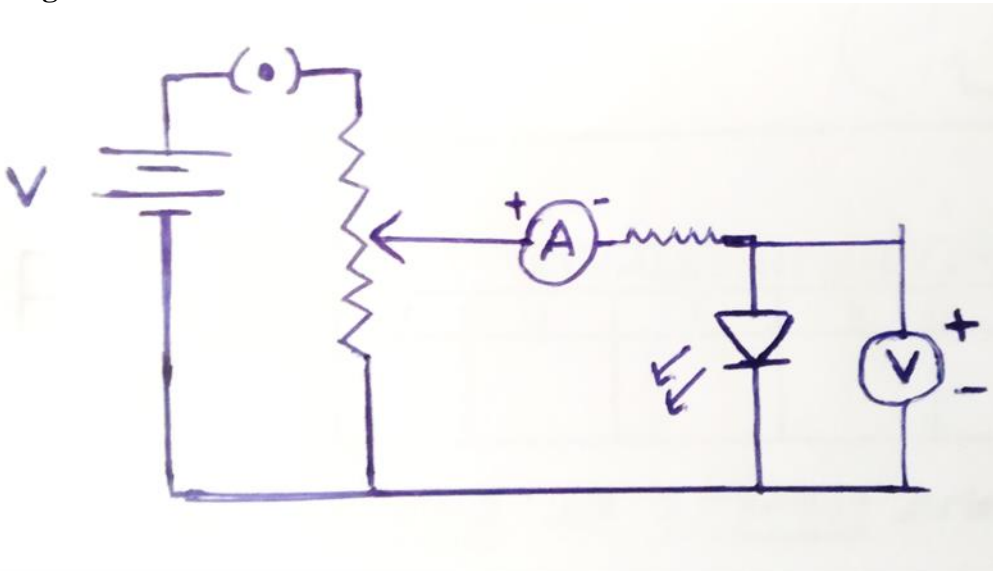F Y B Tech SEM I 2021-22
Engineering Physics Lab Course

Planck's constant (using LEDs)

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Aim: To determine the Planck's constant using LEDs.

Apparatus: 0-10V Power Supply, one way key, rheostat, digital voltmeter, 1K resistor, different colored LEDs.

Diagram:

Observation Table:

LED: Red Wavelength:		LED: Yellow Wavelength:		LED: Green Wavelength:	
Voltage (V)	Current (mA)	Voltage (V)	Current (mA)	Voltage (V)	Current (mA)
	0		0		0
V_{th} =1.908	1.590	V_{th} =2.178	1.815	V_{th} =2.434	2.029
2.002	1.669	2.403	2.002	2.601	2.167
2.2	1.834	2.601	2.167	2.804	2.336
2.4	2.002	2.804	2.336	3.002	2.501
2.6	2.167	3.0	2.501	3.2	2.666
3.0	2.501	3.2	2.666	3.402	2.835
3.2	2.666	3.402	2.835	3.6	3.000
3.6	3.000	3.6	3.000	3.803	3.169
4	3.334	4	3.334	4	3.334

V_{th}: Threshold voltage/knee voltage

Sr. No.	Wavelength λ (nm)	$1/\lambda$ (nm^{-1})	V_{th} (volt)
1.	650	0.00154	1.908
2.	570	0.0018	2.178
3.	510	0.0020	2.434

Graphs:
1. Plot voltage (X-axis) v/s current (Y-axis) for different three LEDs: Red, Yellow and Green on the same graph paper
2. Plot threshold voltage (X-axis) v/s reciprocal of wavelength (Y-axis)
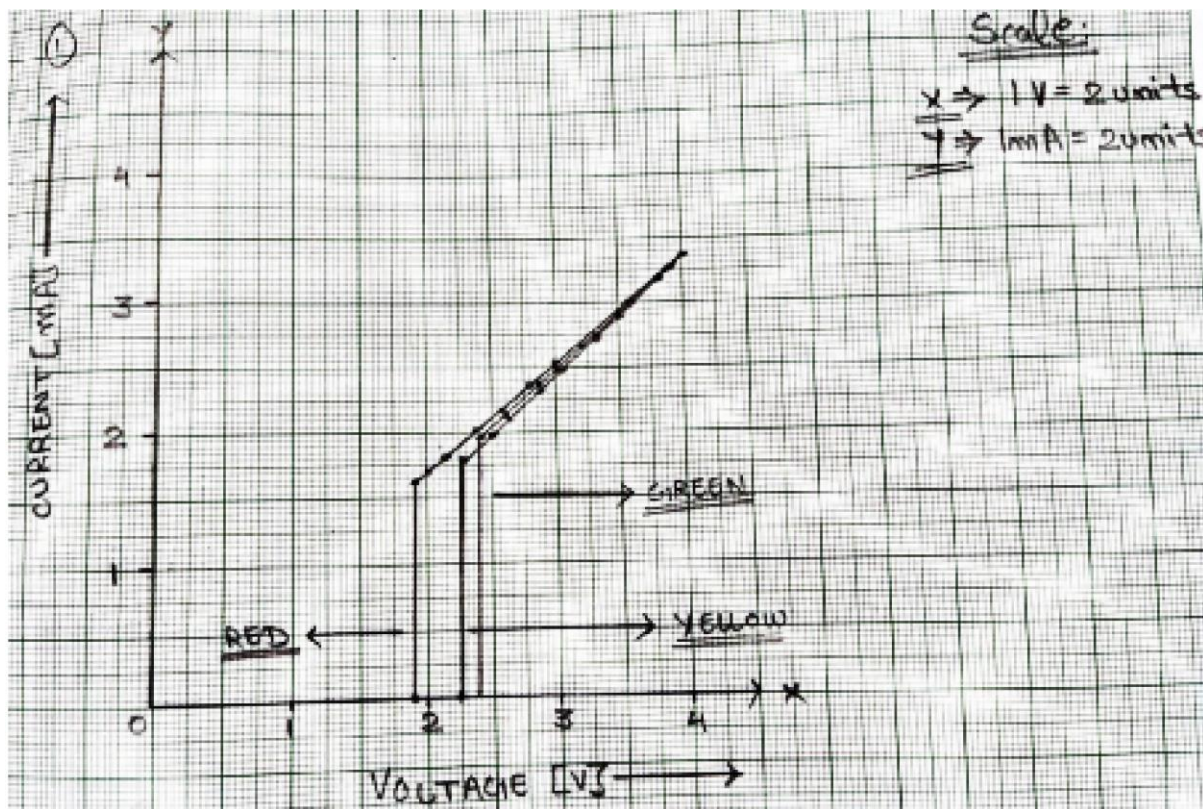
Calculation:
Determine slope of the graph #2 above. Calculate Planck's constant using:

$$h = slope \times \frac{e}{c}$$

Where
e = 1.6 x 10^{-19} C
c = 3 x 10^{8} m/s

Given : $e = 1.6 \times 10^{-19} C$.

$c = 3 \times 10^8 m/s$.

To find : h (Planck's const.)

Formula : $h = m \times \dfrac{e}{c}$ (m = slope)

Solution: $h = m \times \dfrac{e}{c}$

$= 1.29 \times 10^{-6} \times \dfrac{1.6 \times 10^{-19}}{3 \times 10^8}$

$= \boxed{6.8 \times 10^{-34} \text{ JS}}$

Determine wavelength of LED using

$\lambda = \dfrac{slope}{V_{th}}$

Given : slope (m) $= 1.29 \times 10^{-6}$

$V_{th} = 2.62V$.

To find : λ.

Formula : $\lambda = \dfrac{m}{V_{th}} = \dfrac{1.29 \times 10^{-6}}{2.62}$

$= \boxed{0.4923 \times 10^{-6} m}$