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ECE – A

Physics: Electromagnetic Theory, Quantum Mechanics, Waves and Optics- 18PYB101J

EXPERIMENT-V

28.05.21

DETERMINATION OF PLANCK'S CONSTANT

AIM:

To determine Planck's Constant by measuring the turn-on Voltage of Several LED's.

APPARATUS:

Planck's Kit.

FORMULA:

$h = E\lambda/C$ (Js)

$E = eV$ (joule)

where, h - Plancks Constant (Js)
E - Energy (Joule)
C - Velocity of light (m/s)
λ - Wavelength of Different Colour of LED (m).
V - Turn on Voltage (Volt).
e - Charge of electron (C)

OBSERVATION:

Charge of Electron, $e = 1.6 \times 10^{-19}$ C.

Velocity of Light, $c = 3 \times 10^{8}$ m/s.

CALCULATION:

1. $E = eV$; $h = E\lambda/C$; $C/\lambda = 4.61 \times 10^{-4}$

$E = 1.6 \times 10^{-19} C \times 1.81$
$= 2.896 \times 10^{-19}$ J

$h = (2.896 \times 10^{-19} J \times 650 \times 10^{-9} m) / 3 \times 10^{8}$ m/s
$= 6.274 \times 10^{-34}$ Js.

2. $E = eV$; $h = E\lambda/C$. $C/\lambda = 5 \times 10^{-4}$

$E = 1.6 \times 10^{-9} C \times 2.06$
$= 3.296$ J $\times 10^{-19}$

$h = (3.296$ JJ $\times 600 \times 10^{-9} m) / 3 \times 10^{8}$ m/s $= 6.592 \times 10^{-34}$ JS

3. $E = eV_s$; $h = E\lambda/C$ $\qquad c/\lambda = 5.45 \times 10^{-4}$

$E = 1.6 \times 10^{-19}\ C \times 2.35$

$= 3.76 \times 10^{-19}\ J$

$h = (3.76 \times 10^{-19}\ J \times 550 \times 10^{-9}\ m) / 3 \times 10^{8}\ m/s$

$= 6.893 \times 10^{-34}\ JS$

4. $E = eV_s$; $h = E\lambda/C$ $\qquad c/\lambda = 6.66 \times 10^{-4}$

$E = 1.6 \times 10^{-19}\ C \times 2$

$= 4.19 \times 10^{-19}\ J$

$h = (4.19 \times 10^{-19}\ J \times 450 \times 10^{-9}\ m) / 3 \times 10^{8}\ m/s$

$= 6.288 \times 10^{-34}\ JS$

Mean $h = [(6.274 + 6.592 + 6.893 + 6.288)/4] \times 10^{-34}\ JS$

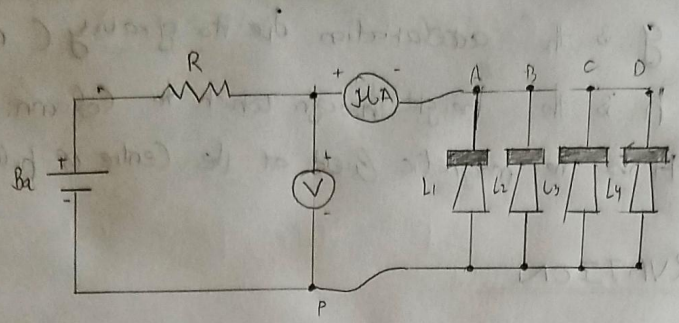
$h = 6.511 \times 10^{-34}\ JS$

RESULT:

Plancks Constant: (i) By Theory $= 6.626 \times 10^{-34}\ JS$

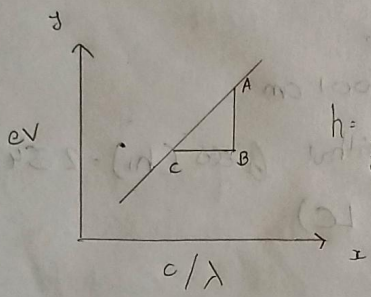
(ii) By Graph $= 6.511 \times 10^{-34}\ JS$

DETERMINATION OF PLANCKS CONSTANT



Plancks Constant Set up

Model Graph:

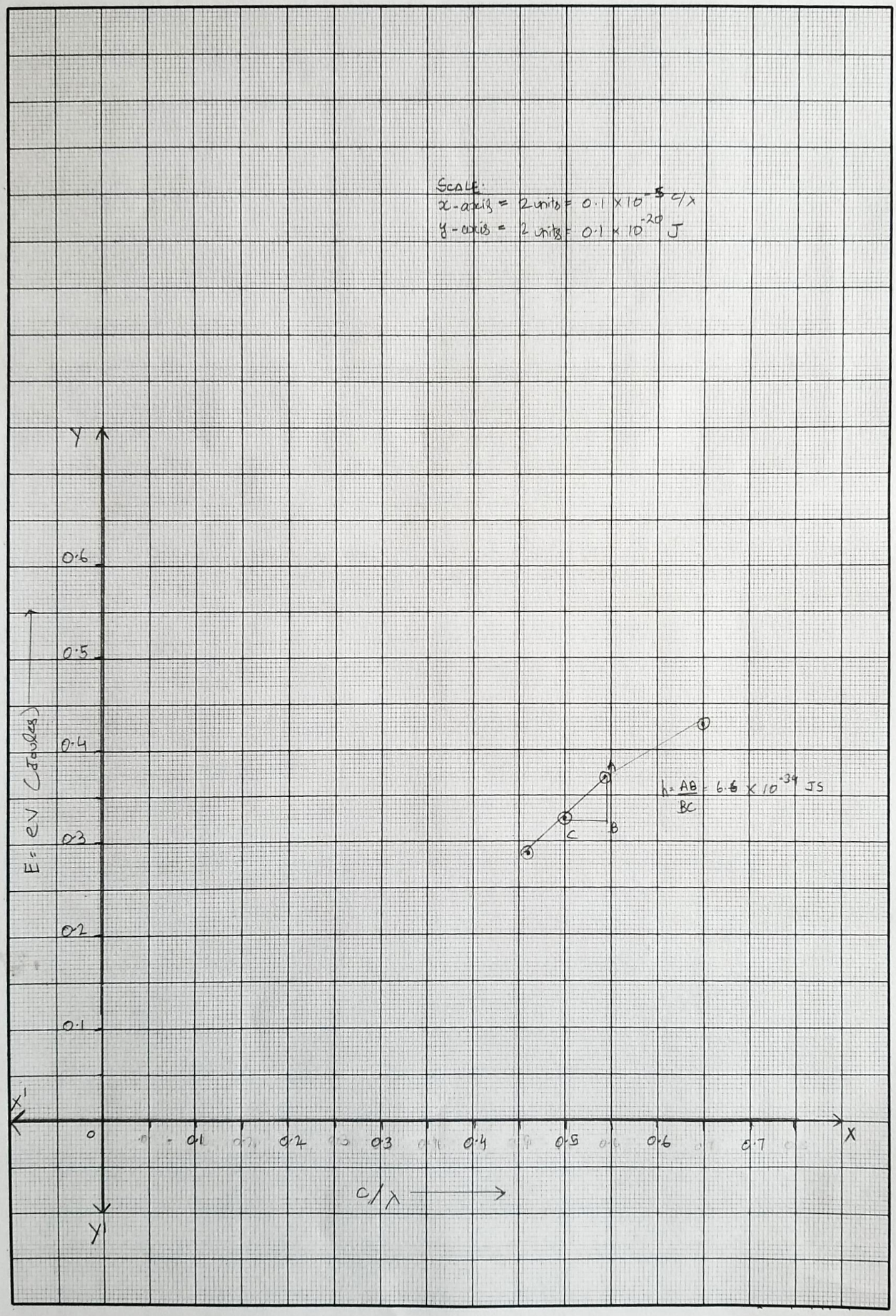


$h = \frac{AB}{BC}$

Table to Calculate Plancks Constant:

S.No	LED Colour	WAVELENGTH (λ) nm	VOLTAGE (V)	$\frac{c}{\lambda}$	E = eV (Joules)	h = E × λ/c (Js)
1.	Red	650	1.81	4.61×10^{-4}	2.896×10^{-19}	6.274×10^{-34}
2.	Orange	600	2.06	5×10^{-4}	3.296×10^{-19}	6.592×10^{-34}
3.	Green	550	2.35	5.45×10^{-4}	3.76×10^{-19}	6.893×10^{-34}
4.	Blue	450	2.62	6.66×10^{-4}	4.19×10^{-19}	6.285×10^{-34}

Mean(h) = 6.511×10^{-34} Js


Scale:
x-axis = 2 units = 0.1 × 10^-5 c/λ
y-axis = 2 units = 0.1 × 10^-20 J
Y
0·6
0·5
0·4
0·3
0·2
0·1
E = eV (Joules)
X'
0
0·1
0·2
0·3
0·4
0·5
0·6
0·7
X
c/λ
Y'
C
B
h = AB/BC = 6·6 × 10^-34 JS