DATE | PAGE NO. | EXPT. NO.

EXPERIMENT-7

DETERMINATION OF PLANCK'S CONSTANT

AIM: Determination of Planck's Constant

APPARATUS: 0-1 V power supply, a one way key, a rheostat, a digital miliammeter, a digital voltmeter, a 1K resistor and different known wavelength LED's (Light Emitting Diode).

THEORY: The significance of planck's constant is that 'quanta' (small packets of energy can be determined by frequency of radiation and planck's constant. It describes the behaviour of particle & waves at atomic level as well as the particle nature of light

The light energy emitted during forward biasing is given as,

$$E = \frac{hc}{\lambda} \quad \text{---(1)}$$

where c = velocity of light
h = planck's constant
λ = wavelength of light

DATE | PAGE NO. | EXPT. NO.

If V is the forward voltage applied across the LED where it begins to emit light (the knee voltage) the energy given to electrons crossing the function is

$$E = eV \quad (2)$$

equating (1) and (2) we get

$$eV = \frac{hc}{\lambda} \quad - (3)$$

the voltage V can be measured for LED's with different values of λ (wavelength of light)

$$V = \frac{hc}{e}\left(\frac{1}{\lambda}\right) \quad — (4)$$

Now from eq (4), slope of graph of V on the vertical axis vs $1/\lambda$ on the horizontal axis is

$$S = \frac{hc}{e}$$

To determine planck's constant h,

$$h = \frac{e}{c} S \quad \left(\text{from value } h = \frac{e}{c} = 5.33 \times 10^{-28} \text{ cs/m}\right)$$

Alternatively, eq (3) can be written as

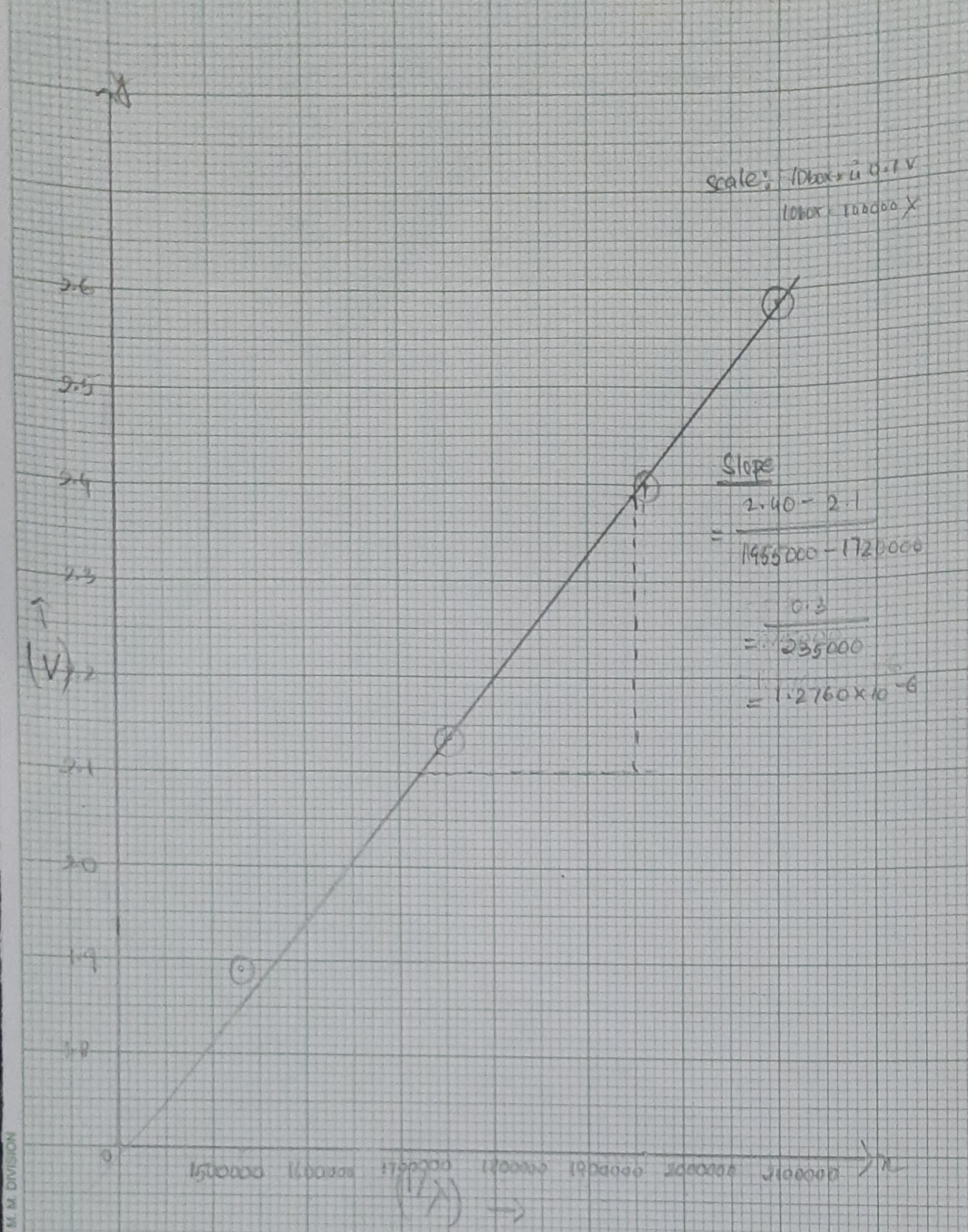
$$h = \frac{e}{c}\lambda V$$

DATE | PAGE NO. | EXPT. NO.

OBSERVATIONS :

COLOUR OF LED	WAVELENGTH (λ) (nm $\times 10^{-9}$ m)	VOLTAGE (V)	λV (Vm)	$h = \frac{e \lambda V}{c}$ (Js) PLANCK'S CONSTANT
Red	650×10^{-9}	1.89	1228.5×10^{-9}	6.54×10^{-34}
Green	510×10^{-9}	2.40	1224×10^{-9}	6.52×10^{-34}
Yellow	570×10^{-9}	2.14	1219.8×10^{-9}	6.50×10^{-34}
Blue	475×10^{-9}	2.59	1230.2×10^{-9}	6.55×10^{-34}

Mean = 6.5275×10^{-34} Js


scale: 10box = 0.1 V
10box = 100000 X
2.6
2.5
2.4
2.3
(V)
2.1
2.0
1.9
1.8
0
1500000
1600000
1700000
1800000
1900000
2000000
2100000
(λ)
Slope
2.40 - 2.1
1955000 - 1720000
0.3
235000
1.2760 × 10⁻⁶

DATE | PAGE NO. | EXPT. NO.

$\frac{1}{\lambda}$	V
1538461.538	1.89
1960784.314	2.40
1754385.965	2.14
2105263.158	2.59

CALCULATION :

$$\text{Slope} = \frac{2.40 - 2.1}{1955000 - 1720000}$$

$$= \frac{0.3}{235000}$$

$$= 1.2760 \times 10^{-6}.$$

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

$$= 5.33 \times 10^{-28} \times 1.2760 \times 10^{-6}$$

$$= 6.8010 \times 10^{-34} \text{ Js}.$$

∴ Graphical Planck's Constant = 6.8010×10^{-34} Js.

Error = $\frac{O_1 - O_2}{100}$ = $\frac{(\text{Observed planck's constant} - \text{graphical planck's constant})}{100}$

$$= \frac{6.8010 \times 10^{-34} - 6.5275 \times 10^{-34}}{100} = 2.735 \times 10^{-37}$$

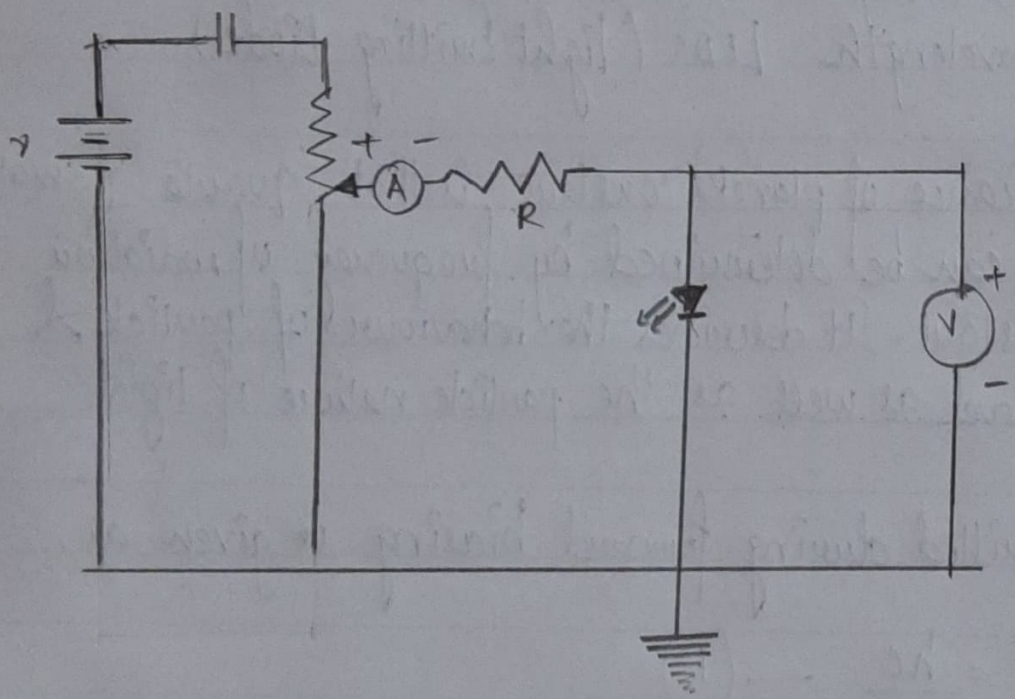
DATE | PAGE NO. | EXPT. NO.

CONCLUSION :-

a) Observed Planck's Constant = 6.5275×10^{-34} Js

b) Graphical Planck's Constant = 6.8010×10^{-34} Js

—x—x—



CIRCUIT DIAGRAM