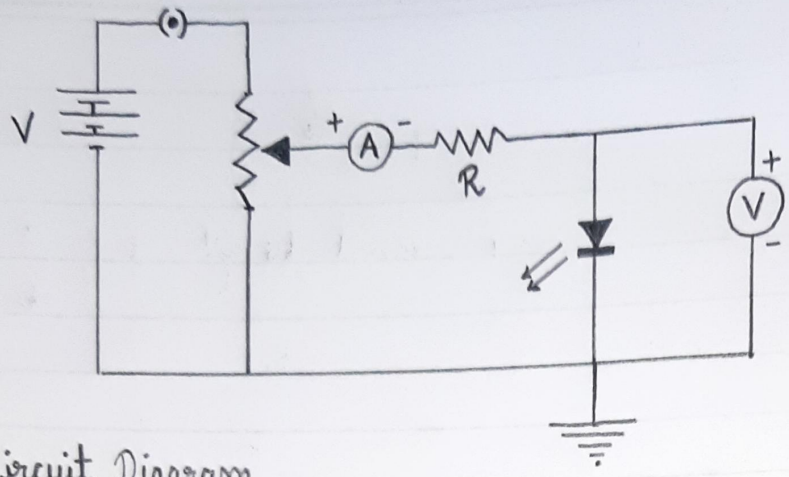



Circuit Diagram ,,

## Observations:

| Colour | Wavelength, $\lambda$ (nm) | Knee Voltage, V (volts) | $\lambda.V$ | $h = \frac{e}{c}\lambda V$ (Js) | $\frac{1}{\lambda}$ ($\mu m^{-1}$) |
|---|---|---|---|---|---|
| Red | 650 | 1.908 | 1240.2 | $6.610266 \times 10^{-34}$ | 1.5384615 |
| Green | 510 | 2.434 | 1241.34 | $6.616342 \times 10^{-34}$ | 1.9607843 |
| Yellow | 570 | 2.178 | 1241.46 | $6.61698 \times 10^{-34}$ | 1.754386 |
| Blue | 475 | 2.615 | 1242.125 | $6.62053 \times 10^{-34}$ | 2.1052632 |

## Calculations:

Mean value of h, $h_{mean} = \frac{6.610266 + 6.616342 + 6.61698 + 6.62053}{4} \times 10^{-34}$

$h_{mean} = 6.6160295 \times 10^{-34}$ Js

Slope of graph, $S = \frac{2.615 - 1.908}{2.1052632 - 1.5384615} \simeq 1.24735 \times 10^{-6}$

Value of h from graph, $h_{graph} = 5.33 \times 1.24735 \times 10^{-34}$

$= 6.648374555 \times 10^{-34}$ Js

# Experiment 8.

## Aim:

Determination of Plank's constant.

## Apparatus:

0-10V power supply, a one way key, a rheostat, a digital milliammeter, digital voltmeter, 1k resistor and different known wavelength LED's.

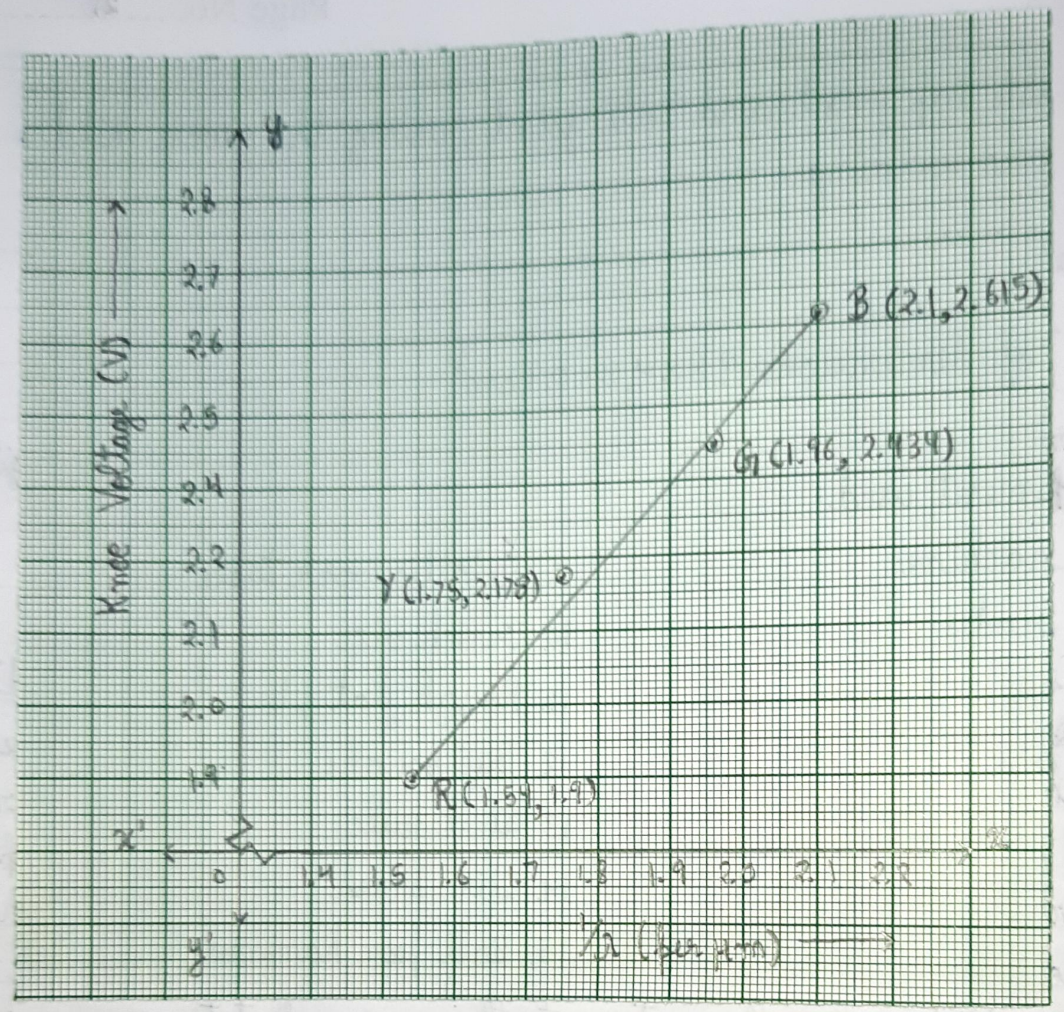
## Theory:

An LED is a two terminal semiconductor light source. In the unbiased condⁿ a potential barrier is developed accross the p-n junction of the LED. When we connect the LED to an external voltage in the forward biased direction, the height of potential barrier across the p-n junction is reduced. At a pt. particular voltage the height of potential barrier becomes very low & the LED starts glowing ie. in the forward biased condition electrons crossing the junction are excited & when they return to their normal state, energy is emitted. This particular voltage is called the knee voltage or the threshold voltage. Once the knee voltage is reached, the current may increase but the voltage does not change.

## Formula used:

$$E = \frac{hc}{\lambda}$$

where, c is velocity of light.
h is planks constant.
$\lambda$ is wavelength of light.




Error (%) Calculation:

Standard value of $h$, $h_0 = 6.62607015 \times 10^{-34}$ Js

Percentage error in $h_{av}$ ,, $\%e_1 = \frac{h_0 - h_{av}}{h_0} \times 100 = 0.1915325\%$

Percentage error in $h_{graph}$ ,, $\%e_2 = \frac{h_0 - h_{graph}}{h_0} \times 100 = 0.33661589\%$

Percentage error in $h_{graph}$ wrt $h_{av}$ ,, $\%e_3 = \frac{h_{av} - h_{graph}}{h_{av}} \times 100 = 0.48889\%$

& as we know, $E = eV$

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

where, $\frac{e}{c} = 5.33 \times 10^{-28} \frac{C_s}{m}$

## Procedure:

(i) Make the connections as shown in circuit diagram.
(ii) Insert key to start the experiment.
(iii) Adjust the rheostat value till the LED starts glowing, or in the case of the IR diode, whose light is not visible, until the ammeter indicates that current has begun to increase. (but here we don't take IR diode)
(iv) Corresponding voltage across the LED is measured using a voltmeter, which is the knee voltage.
(v) Repeat, by changing LED & note down corresponding knee voltage.
(vi) Using the formula given, find value of Plank's constant.

## Results:

Average value of Plank's constant, $h_{av} = 6.6160295 \times 10^{-34}$ Js
Plank's constant from graph, $h_{graph} = 6.648374555 \times 10^{-34}$ Js
Percentage error in $h_{av}$, $\%e_1 = 0.1515325\%$
Percentage error in $h_{graph}$, $\%e_2 = 0.33661589\%$
Percentage error in $h_{graph}$ wrt $h_{av}$, $\%e_3 = 0.48889\%$

## Precautions & Sources of error:

1. Connections must be proper & tight.
2. To measure exact Knee Voltage, increase rheostat value slowly.
3. Graph should be straight line.

Teacher's Signature : _____