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Title of the experiment:-

Interaction of light with matter. Determination of Planck's constant by Photo Electric Effect.

Objective :-

Determination of Planck's constant.

Equipment list:-

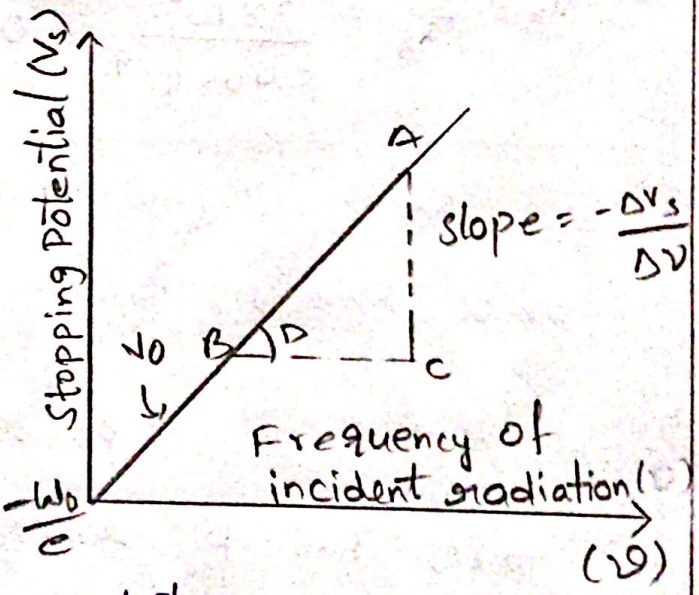
1. Photosensitive Device : Vaccum phototube.
2. Light source : Halogen tungsten lamp 12V/35W
3. Colour Filters : Red (635 nm), Yellow - I (570nm), Yellow - II (540nm), Green (500nm) & Blue (460nm).
4. Accelerating voltage : Regulated Voltage Power Supply.
5. Current Detecting unit.

Formulas :-

$$h\nu = \frac{1}{2}mv^2 + e\phi$$

$$E_e = \frac{1}{2}mv^2 = eV_s$$

$$V_s = \frac{h\nu}{e} - \phi$$



Calculations:-

Planck's constant: $h = e\frac{\Delta V_s}{\Delta \nu}$

Where e is the charge of the electron.

The value of $\frac{\Delta V_s}{\Delta \nu}$ can be obtained from the graph and can be substituted to calculate the planck's constant.

Laboratory Report :-

S.NO.	Filters used (wavelength)	ν (Hz)	Stopping voltage (V)
1.	Red (635 nm)	4.72×10^{14}	-0.29
2.	Yellow I (570 nm)	5.26×10^{14}	-0.42
3.	Yellow II (540 nm)	5.55×10^{14}	-0.61
4.	Green (500 nm)	6.0×10^{14}	-0.76
5.	Blue (460 nm)	6.52×10^{14}	-1.02

Frequency calculation :-

$\rightarrow \nu = \frac{c}{\lambda}$

$\Rightarrow \nu_1 = \frac{c}{\lambda_1} = \frac{3 \times 10^8}{635 \times 10^{-9}} = 0.00472 \times 10^{17} = 4.72 \times 10^{14}$

$\Rightarrow \nu_2 = \frac{c}{\lambda_2} = \frac{3 \times 10^8}{570 \times 10^{-9}} = 0.00526 \times 10^{17} = 5.26 \times 10^{14}$

$\Rightarrow \nu_3 = \frac{c}{\lambda_3} = \frac{3 \times 10^8}{540 \times 10^{-9}} = 0.00555 \times 10^{17} = 5.55 \times 10^{14}$

$\Rightarrow \nu_4 = \frac{c}{\lambda_4} = \frac{3 \times 10^8}{500 \times 10^{-9}} = \frac{3 \times 10^8}{5 \times 10^{-7}} = 0.6 \times 10^{15}$

$= 6.0 \times 10^{14}$

$\Rightarrow \nu_5 = \frac{c}{\lambda_5} = \frac{3 \times 10^8}{460 \times 10^{-9}} = \frac{3 \times 10^8}{46 \times 10^{-8}} = 0.0652 \times 10^{16}$

$= 6.52 \times 10^{14}$.

Calculations:-

planck's constant $h = e \cdot \frac{\Delta V_s}{\Delta V}$

$$h = (1.602 \times 10^{-14}) \left(\frac{(-0.29) - (-1.02)}{(6.52 \times 10^{14}) - (4.72 \times 10^{14})} \right)$$

$$= 1.602 \times 10^{-14} \left(\frac{-0.29 + 1.02}{(6.52 - 4.72) 10^{14}} \right)$$

$$= 1.602 \times 10^{-28} \times \frac{0.73}{1.8} = \frac{1.169 \times 10^{-28}}{1.8}$$

$$h = 6.62 \times 10^{-34} \text{ Js}$$

e is charge of electron.

Graphs:-

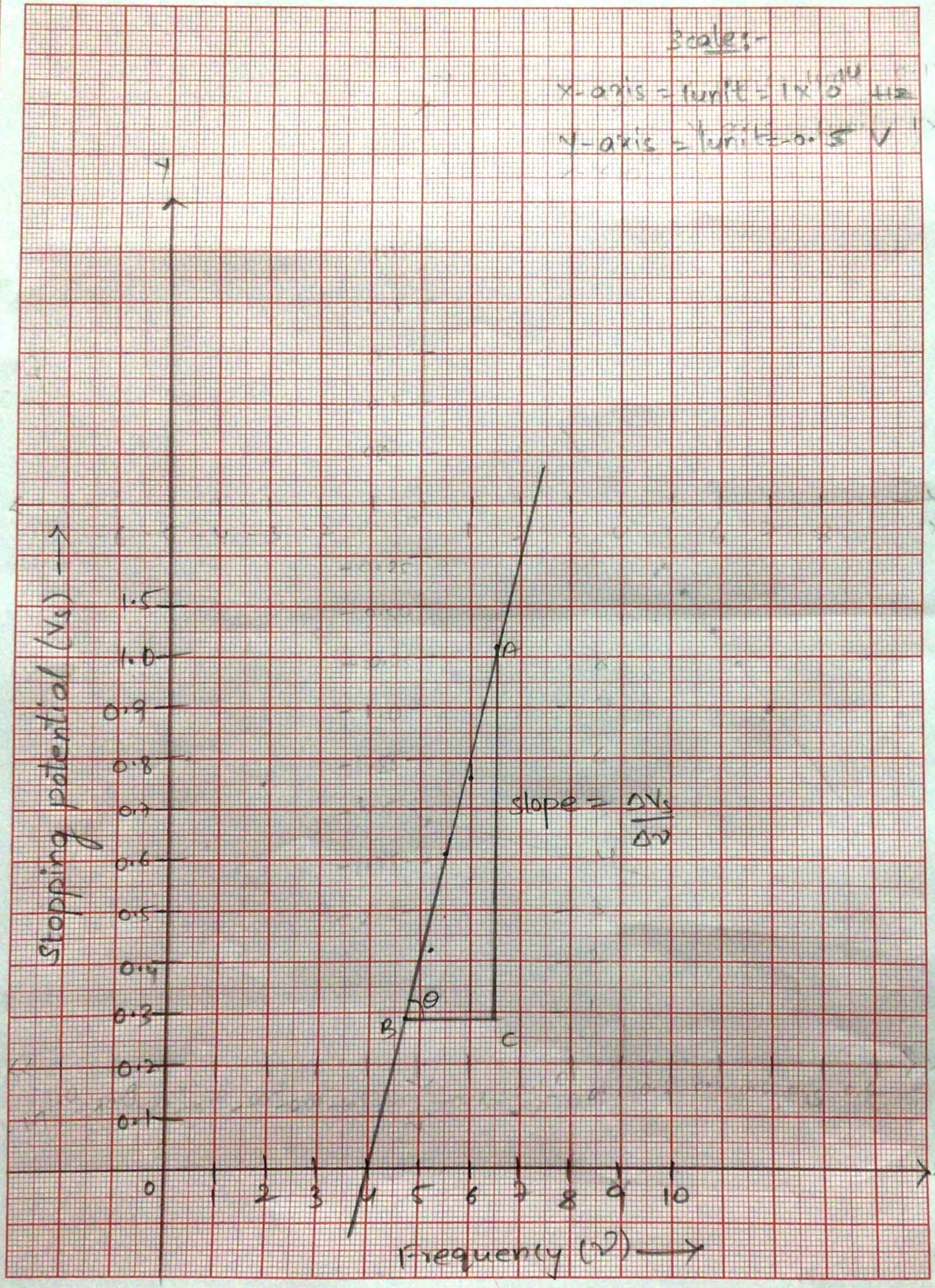
Plot a graph of V_s versus V. The slope of the graph will give the value of $\frac{\Delta V_s}{\Delta y}$. In a addition find the y-intercept of the plot to given the value of work function.

Result:-

Planck's constant calculated from the experiment is $h = 6.626 \times 10^{-34}$ Js

Precautions:-

1. After finishing the experiment switch off the power supply and cover the draw tube with the lens cover provided. Phototube is light sensitive device and its sensitivity decreases with exposure to light due to ageing.


Scale:-
x-axis = 1 unit = 1×10^{14} Hz
y-axis = 1 unit = 0.5 V
Y
Stopping potential (V_s) →
1.5
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
$\times 10^{14}$
Frequency (ν) →
A
B
C
θ
slope = $\frac{\Delta V_s}{\Delta \nu}$

GUPTA'S