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Experiment No:- 2

1. Aim: To determine the planck's constant by photo-electric effect

2. Apparatus Required: Light source, Photoelectric tube, Voltmeter(V), Ammeter (μA), Connecting wires.

3. Theory:

When light source of suitable frequency falls on the metal surface, electrons are ejected from it and this phenomenon is called photoelectric effect. These electrons are known as photoelectrons and the resulting current is photoelectric current.

The photoelectric effect is an instantaneous process.

The number of photoelectrons emitted is proportional to the intensity of incident light. Also, the energy of emitted photoelectrons is directly independent of the intensity of incident light. The energy of emitted electrons is directly proportional to the frequency of incident light.

Equation for photoelectric effect

$$h\nu = KE_{max} + W \quad \text{---(i)}$$

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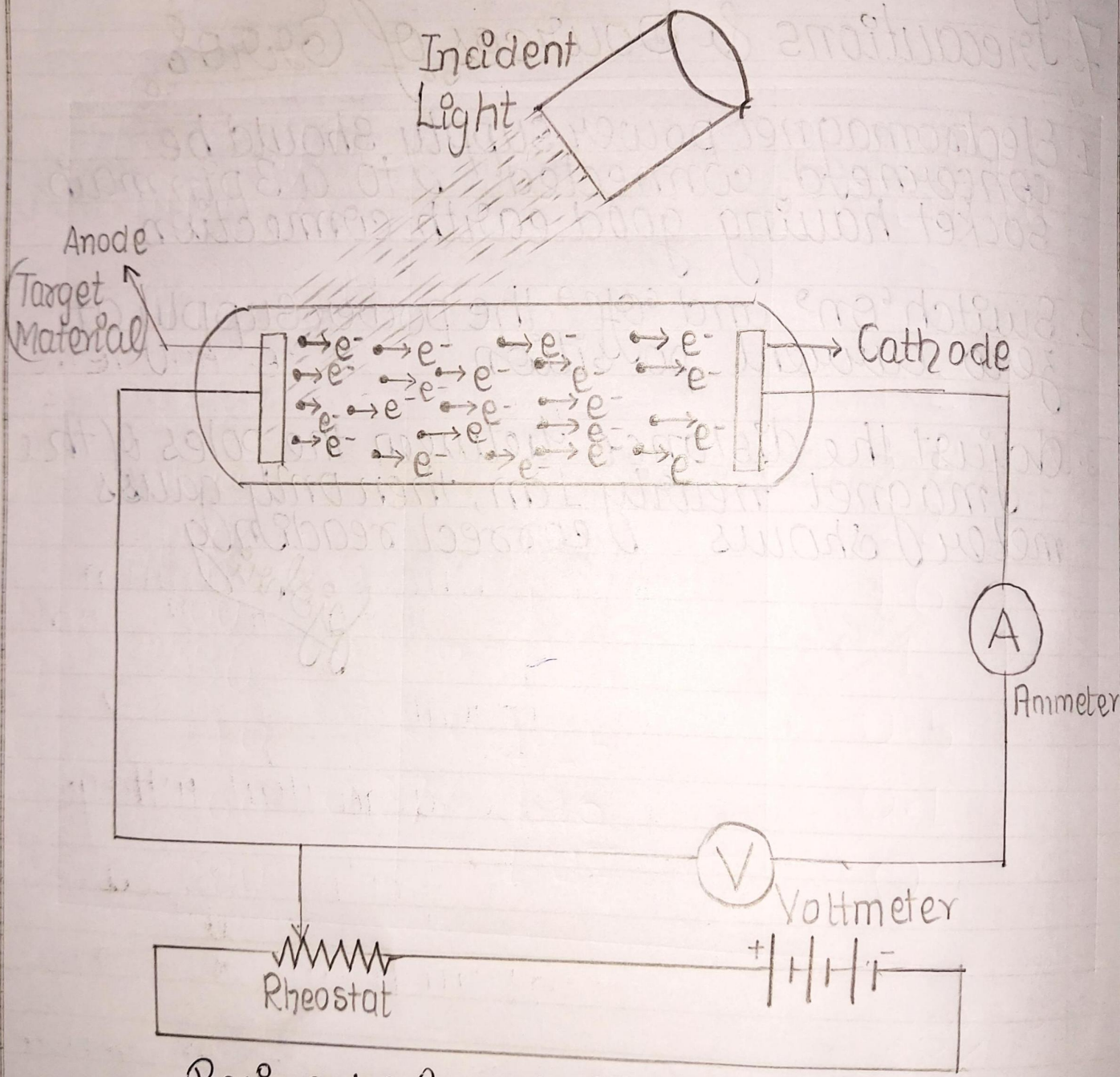

Basic experimental setup for photoelectric effect

Fig (i)

Fig (i)

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where,

$h\nu$ = Energy of incident photon

KE_{max} = Maximum KE of ejected electron

$KE_{max} = eV_0$ ——(ii)

where,

$e = 1.6 \times 10^{-19} C$ (electron charge)

V_0 = Stopping potential (Minimum Voltage required to stop ejection of photo-electrons)

$W = h\nu_0$ —(iii)

W = Work function of metal

ν_0 = Threshold frequency (Minimum frequency for photo electric effect)

4. Procedure

1. Select the material studying photoelectric effect
2. Select area of material, wavelength, intensity of incident light
3. Switch on the light source
4. Measure the reverse current
5. Determine the threshold Voltage
6. Repeat the experiment by varying the intensity for a particular wavelength of incident light
7. Repeat the experiment for approx 10 readings

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Observation Table

for copper.

S.No	Wavelength (nm) (λ)	Frequency (ν) (10^{15}) Hz	Stopping (V_0) Potential in V
1	100	3	7.8
2	120	2.5	5.7
3	140	2.14	4.2
4	160	1.875	3.1
5	180	1.67	2.2
6	200	1.5	1.6
7	220	1.36	1
8	240	1.25	0.5
9	260	1.15	0.1
10	280	1.07	0

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Calculations

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

$$\text{slope} = \frac{(6.7 - 3.6)}{(2.75 - 2) \times 1015}$$

$$= 4.13 \times 10^{-15}$$

$$h = (4.13 \times 10^{-15}) \times (1.6 \times 10^{-19})$$

$h = 6.608 \times 10^{-34}$ J s Ans

Percentage Error calculations

Actual $h = 6.626 \times 10^{-34}$

$$\% \text{ error} = \left(\frac{6.626 - 6.608}{6.626}\right) \times 100\%$$

$= 0.27\%$ Ans

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Experiment no:- 2

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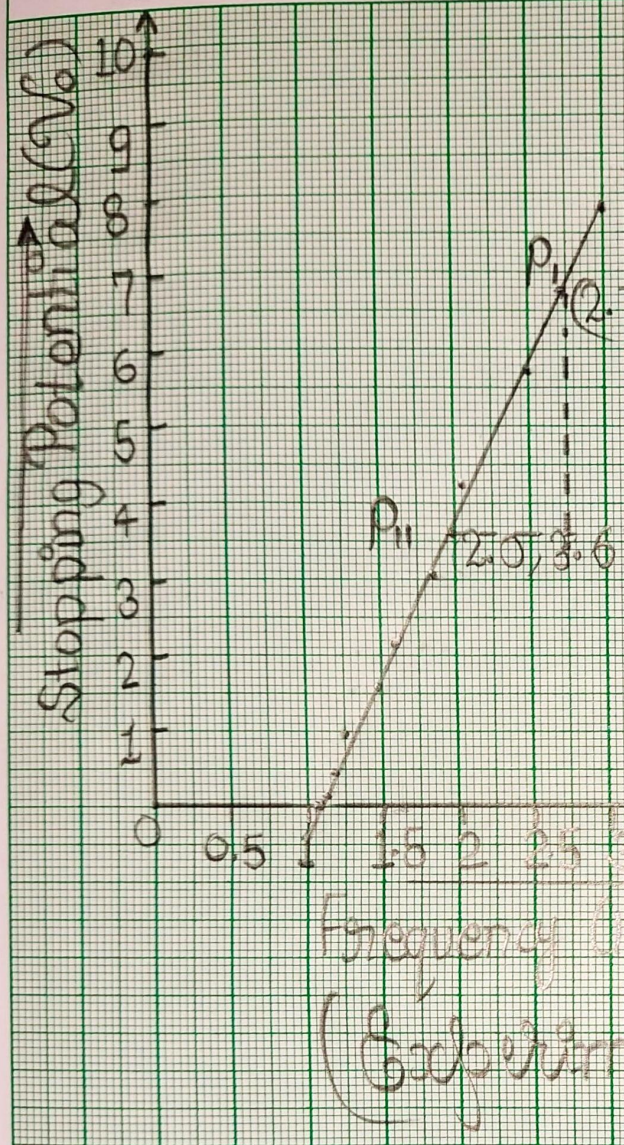
2K20/B17/33



Scale

Along X axis

1 cm = 0.5 Hz

Along Y axis

1 cm = 1 V0

Slope = $\left(\frac{6.7-3.6}{2.75-2.0}\right)$

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5. Result:

Planck's constant comes out to be

6.608 x 10-34 J s Ans and % error = 0.27% Ans

6. Precautions and Sources of Error

1. Switch on the light before applying voltage.
2. Voltage should be lowered slowly until reached stopping potential
3. Make sure to set area of plots to maximum

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