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Planck's Constant using Photoelectric effect

Aim - Measurement of planck's constant using Photoelectric effect and determine work function and thresh hold frequency of cathode material.

Apparatus - Light Source, Vacuum tube, Voltage Source, Ammeter.

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

f = frequency
λ = wavelength
E = Energy
c = velocity of light
h = planck's constant.

$$hf = \frac{1}{2} m u^2 + e\phi$$

m = mass of $e^{\ominus}$
e = charge of $e^{\ominus} = 1.6 \times 10^{-19}$ C
u = velocity of $e^{\ominus}$
ϕ = work function.

$$hf = eV_s + e\phi$$

$$V_s = \frac{hf}{e} - \phi$$

Teacher's Signature

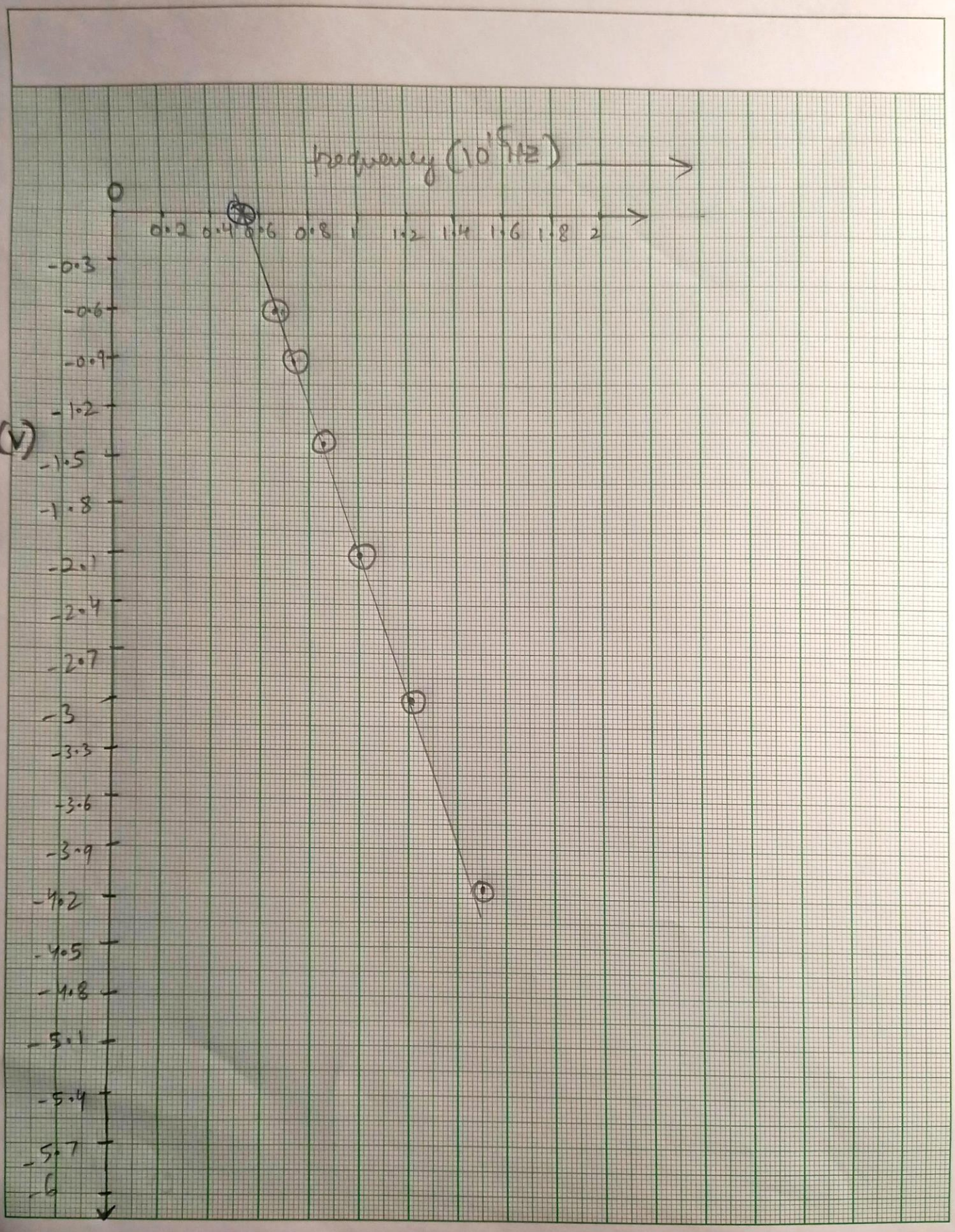
Observations

Material of the plate – Sodium

Area of plate $= 0.3 cm^2$

Intensity of light $= 15 W/m^2$

S.No	Wavelength, λ (nm)	frequency $= c/\lambda$ (10^{15} Hz)	Mag. of Stopping potential V_s (Volt)
1	150	2	−6.06
2	200	1.5	−4.3
3	250	1.2	−3
4	300	1	−2.1
5	350	0.85	−1.4
6	400	0.75	−0.9
7	450	0.67	−0.6


frequency (10^5 Hz)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
V_S(V)
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
-2.7
-3
-3.3
-3.6
-3.9
-4.2
-4.5
-4.8
-5.1
-5.4
-5.7
-6

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Calculations:

$$\text{Slope} = \frac{-6.6+1.4}{2-0.85} = \frac{-5.2}{1.15} = -4.52\times10^{-15}$$

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

$$h = 4.52\times10^{-15} \times 1.6\times10^{-19}$$

$$\boxed{h = 7.232\times10^{-34}}$$

$$\boxed{\phi = 2.3\,eV}$$

Threshold frequency $= 0.5\times10^{15}\,Hz$

percentage error

$$\%\text{error} = \frac{7.232-6.636}{6.636}\times100 = \frac{0.596}{6.636} = 8.9\%$$

Results:

Planck's constant $= 7.232\times10^{-34}$

error % $= 8.9\%$

Work function $= 2.3\,eV$

error % $= 0\%$

$$f_0 = 0.5\times10^{15}\,Hz$$

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