EXPT = 6 ELECTRON DIFFRACTION 12/9/16

AIM: To calculate the interplanar spacing of polycrystalline graphite from electron diffraction pattern

To obtain de-Broglie wavelength of electrons at different accelerating voltages

APPARATUS REQUIRED:

Electron diffraction tube, High voltage (up to 10 KV) power supply, connecting wires, plastic measuring scale.

FORMULA:

$$\lambda_{exp} = d\frac{D}{2L}$$

$$\lambda_{theory} = \frac{h}{\sqrt{2meV}}$$

Here $L \rightarrow$ distance between the graphite foil and screen, $D \rightarrow$ diameter of the diffraction ring, $d \rightarrow$ lattice spacing for graphite, $2\theta \rightarrow$ Bragg angle, $V \rightarrow$ accelerating voltage

$$D = K\frac{1}{\sqrt{V}} \quad (\because K = \text{slope of } D \text{ (vs) } 1/\sqrt{V})$$

$$K = \frac{2Lh}{d\sqrt{2me}}$$

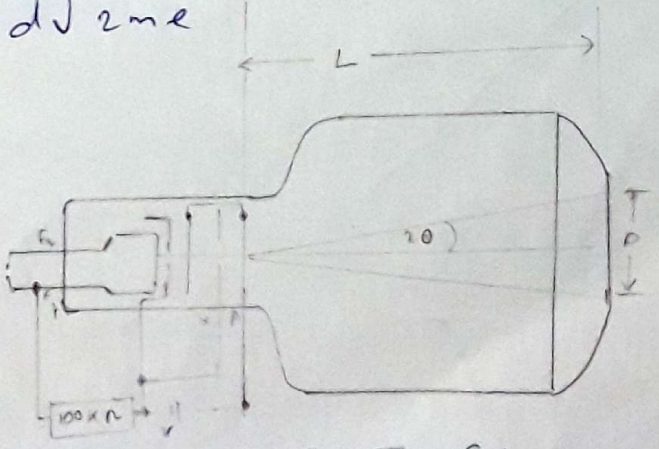


Fig: The Setup

OBSERVATION TABLE:

Distance between graphite sheet and screen (L) = 13.5 cm

For inner ring (d_1)

V (KV)	$1/\sqrt{V}$ $(KV)^{-1/2}$	D_{1in} (cm)	D_{1out} (cm)	D_1 (cm)	λ_{exp} (Å)
3	0.57	2.8	3.2	3	0.555 ≈ 0.56
4	0.50	2.5	2.8	2.65	0.49
5	0.44	2.2	2.4	2.3	0.44

For outer ring (d_2)

V (KV)	$1/\sqrt{V}$ $(KV)^{-1/2}$	D_{2in} (cm)	D_{2out} (cm)	D_2 (cm)	λ_{exp} (Å)
3	0.57	4.9	5.3	5.1	1.756 ≈ 1.76
4	0.50	4.2	4.6	4.4	1.515 ≈ 1.52
5	0.44	3.8	4.2	4	1.377 ≈ 1.38

RESULT AND INFERENCE:

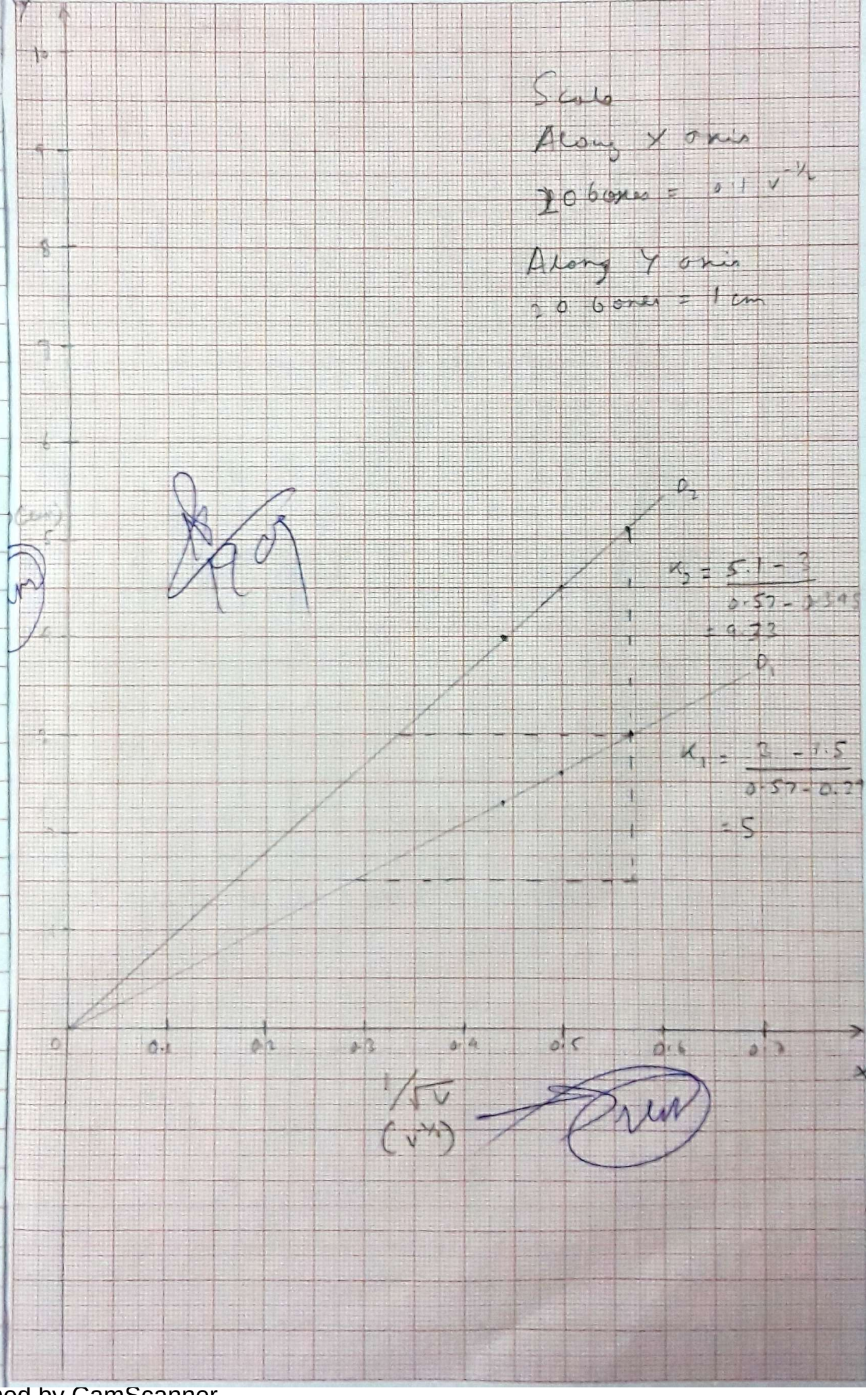
Scale

Along X axis

10 boxes = $0.1\ V^{-1/2}$

Along Y axis

10 boxes = 1 cm



$$\lambda_{exp} = \frac{dD}{2L}$$

for D_1: $\lambda_{exp\,1} = \dfrac{0.62\times10^{-10}\times3.0\times10^{-2}}{2\times13.5\times10^{-2}}$

$= 0.56$ Å

$\lambda_{exp\,2} = \dfrac{0.62\times10^{-10}\times2.65\times10^{-2}}{2\times13.5\times10^{-2}}$

$= 0.49$ Å

$\lambda_{exp\,3} = \dfrac{0.62\times10^{-10}\times2.3\times10^{-2}}{2\times13.5\times10^{-2}}$

$= 0.44$ Å

for D_2:

$\lambda_{exp\,1} = \dfrac{0.34\times10^{-10}\times5.1\times10^{-2}}{2\times13.5\times10^{-2}}$

$= 0.76$ Å

$\lambda_{exp\,2} = \dfrac{0.34\times10^{-10}\times4.1\times10^{-2}}{2\times13.5\times10^{-2}}$

$= 1.52$ Å

$\lambda_{exp\,3} = \dfrac{0.34\times10^{-10}\times4\times10^{-2}}{2\times13.5\times10^{-2}}$

$= 1.38$ Å

CALCULATIONS :

$$K = \frac{2Lh}{d\sqrt{2me}}$$

$$\therefore d = \frac{2Lh}{K\sqrt{2me}}$$

$$\therefore d_1 = \frac{2 \times 13.5 \times 10^{-2} \times 6.6 \times 10^{-34}}{5 \times 10^{-2} \times \sqrt{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19}}}$$

$$= 2.08 \times 10^{-10} \text{ m}$$

$$= 2.08 \text{ Å}$$

$$d_2 = \frac{2 \times 13.5 \times 10^{-2} \times 6.6 \times 10^{-34}}{9.33 \times 10^{-2} \times \sqrt{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19}}}$$

$$= 1.119 \times 10^{-10} \text{ m}$$

$$= 1.12 \text{ Å}$$

RESULT AND INTERFERENCE:

The interplanar spacing in the graph were measured to be :

$d_2 = 1.12$ Å

$d_1 = 2.08$ Å

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