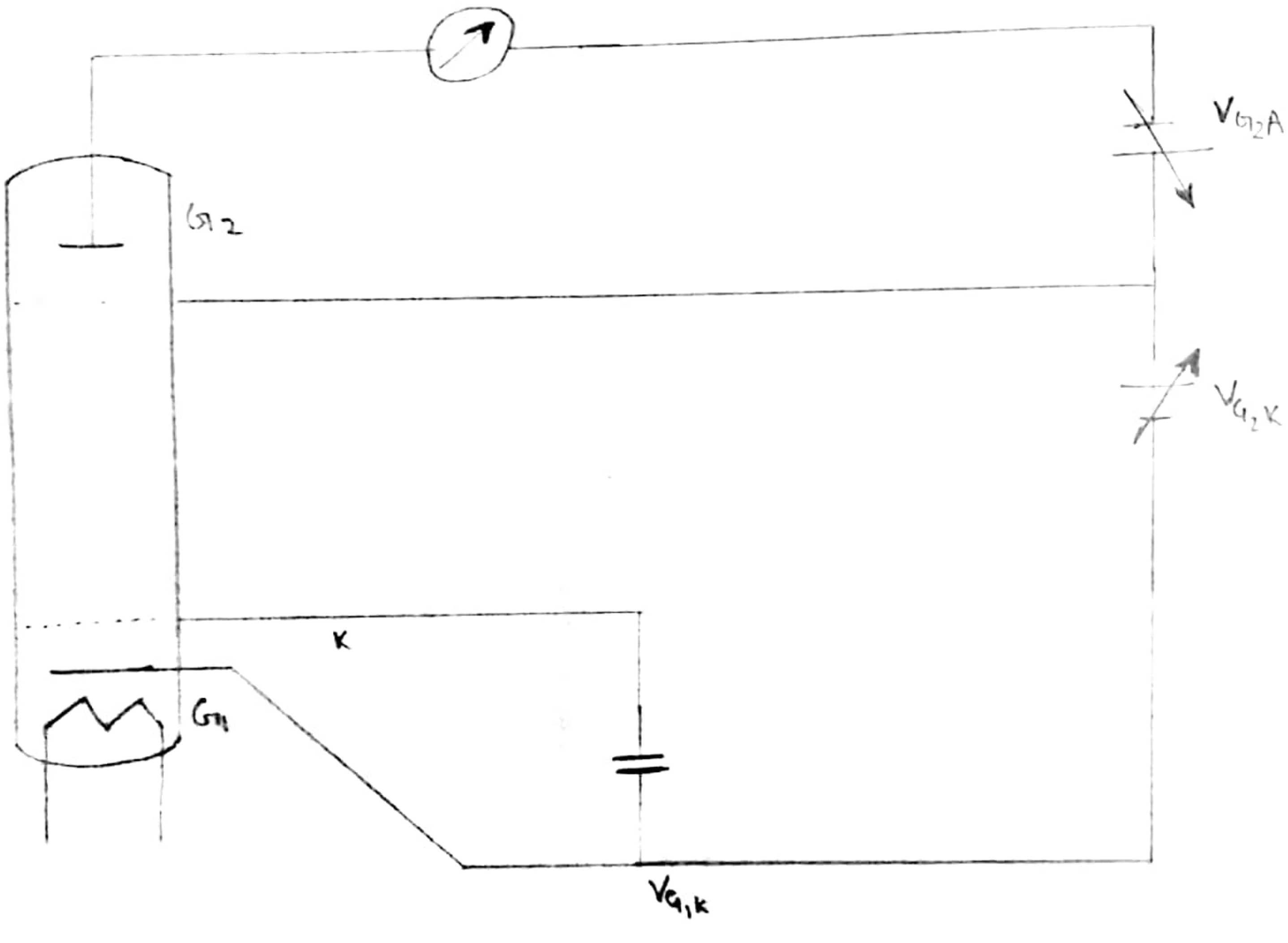

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VERIFICATION OF BOHR'S ATOMIC ORIBATAL THEORY THROUGH FRANK HERTZ EXPERIMENT

WORKING PRINCIPLE : The experimental arrangement is shown in the figure. Frank and hertz used mercury vapour but we used Argon gas. The grid G_1 helps in minimizing space charge effects. The plate A is maintained at a slightly -ve respect to the wire grid G_2 placed just in front of it. Here the electron current is measured as a f^n of the voltage eV_{G_2K}. The electron gain KE in travelling from K to G_2 which becomes max when they reach G_2. If this electron energy is less than the retarding potential eV_{G_2K} between G_2 and the collector, they are unable to reach A making prominent dips in plate current.

Now if an electron travelling from K to G_2 collides with a bound-electron in a gaseous there may be a considerable energy transfer from the impinging electron to the atom electron. According to Bohr's theory, an atomic electron can exist only in different discrete energy levels. If the impinging electron is not sufficient to raise the bound electron from the ground level, where it stays normally, to the first excited energy level by collision, then there will not be any energy transfer between the two in spite of collision i.e the electrons coming from K will then reach the grid G_2 will the full energy gained by them in moving through the potential diff V_{G_2K} and will be able to overcome the retarding potential eV_{G_2A} and fall on A. The ammeter M will the record an electric current. As the pd b/w K and G_2 is ↑, the req. energy by the electron coming from K ↑ and the current recorded by M also ↑. Finally when the electron energy as they reach G_2 becomes = energy diff b/w the grounded state and 1st excited state of the atomic electrons, the latter may be transffered to higher energy by gaining sufficient energy from the incident electrons. Thus the entire energy of an incident electron is transferred to the atomic electron. As these inelastic collision take place just behind the grid

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when this happens, there is a sudden drop in the current recorded by the meter M. The corresponding pd b/w K and G_2 V_{G_2K} is known as resonance potential.

As V_{G_2K} is ↑ further, the plate begins to rise again. The collision b/w the oncoming electrons and the atomic electron now take place some distance behind G_2 towards K so that even after losing their entire energies through collision, the oncoming electrons again acquire sufficient energy when they reach G_2 and are able to overcome the retarding potential to fall on A so that M records some current.

When the pd b/w K and G_2 becomes twice the resonance potential the current suddenly drops again to a low value. The alternate rise and fall of the electron current with the increase in V_{G_2K} occurs repeatedly and the different maxima occurs at potentials b/w two consecutive peaks is equal to the resonance potential.

The nature of variation of the plate current can be interpreted in the following manner: When V_{G_2K} is twice the resonance potential, the electrons coming from K gain energy equal to the energy diff b/w the two levels of the atom when it has travelled half way b/w from K to G_2. so if it collides with an atom at this point, it causes transition of the atom from the ground level to the excited level and looses its energy in the process. It then starts afresh with zero KE towards G_2 and again acquires the same amount of energy on reaching G_2. Collision with a second atom at this point results in the transition of this atom to the upper level where the incident electron again looses its entire KE. As a result it is unable to overcome the retarding potential so that the current recorded the meter M suddenly drops which rise to the second peak.

Similarly the other peaks arise as the oncoming electron collides with larger no of atoms at different points along its path from K to G_2 to cause transitions b/w the levels of the corresponding atoms. These happen at potential that are integral multiples of the resonance potential.

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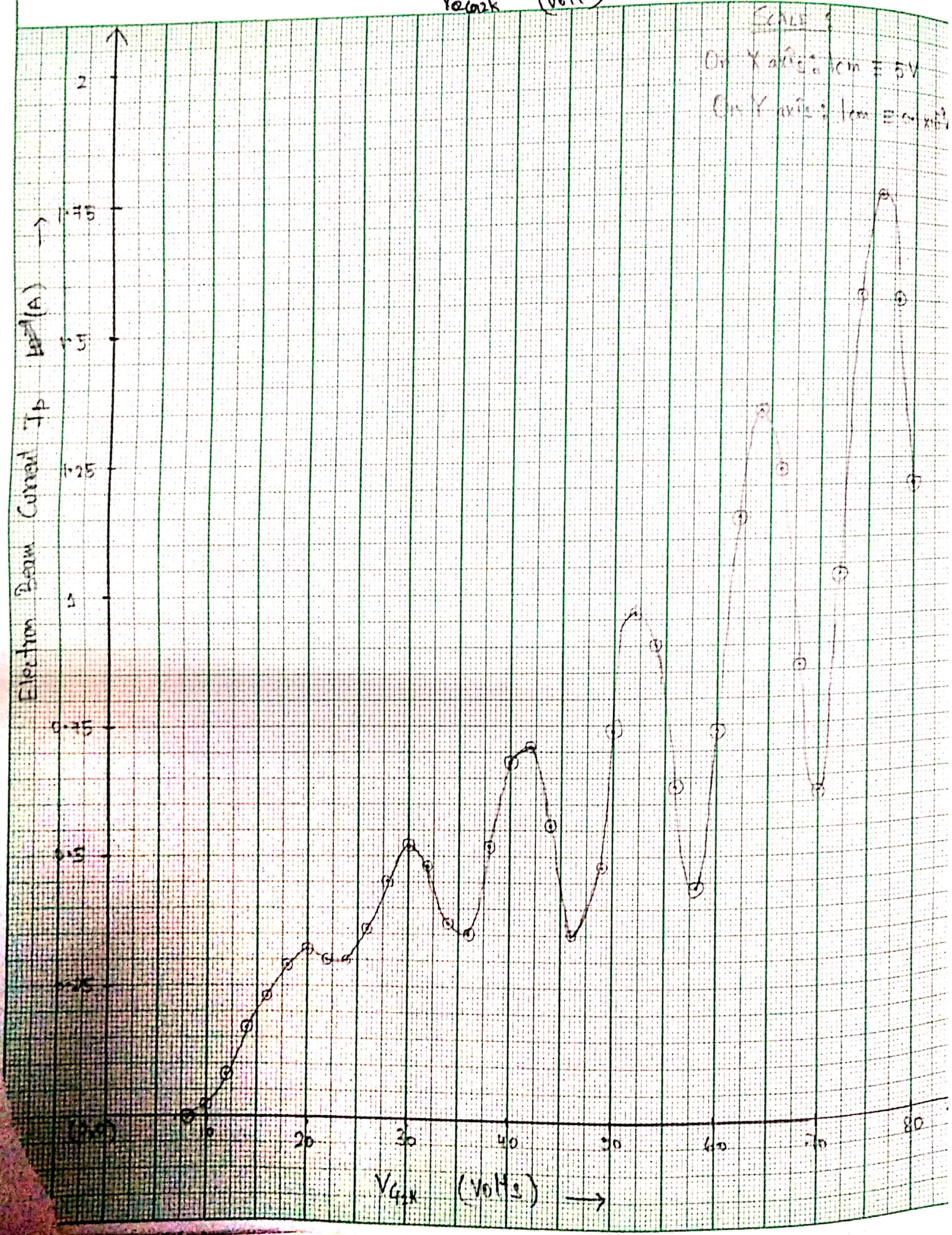
Electron Beam Current (A) Vs V_{G_2K} (Volt)



Date 14/02/2019

Expt. No. 03

OBSERVATION :

SL No.	V_{G_2K} (volt)	$I_p \times 10^{-9}$ (Amp)	SL No.	V_{G_2K} (volt)	$I_p \times 10^{-9}$ (Amp)	SL No	V_{G_2K} (volt)	$I_p \times 10^{-9}$ (A)
1	8	0·00	13	32	0·48	25	56	0·63
2	10	0·02	14	34	0·37	26	58	0·44
3	12	0·08	15	36	0·35	27	60	0·74
4	14	0·17	16	38	0·52	28	62	1·14
5	16	0·23	17	40	0·68	29	64	1·34
6	18	0·29	18	42	0·71	30	66	1·23
7	20	0·32	19	44	0·56	31	68	0·86
8	22	0·30	20	46	0·35	32	70	0·63
9	24	0·30	21	48	0·48	33	72	1·03
10	26	0·36	22	50	0·79	34	74	1·56
11	28	0·45	23	52	0·96	35	76	1·73
12	30	0·52	24	54	0·90	36	78	1·55
						37	80	1·20

CALCULATION (FROM GRAPH) :

Peak No	Peak Voltage (V)	Voltage diff b/w peaks	Avg Voltage diff (V)	Avg Resonance potential (V)
1	20	10		
2	30	12		
3	42	10	11·2	11·2
4	52	12		
5	64	12		
6	76			

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