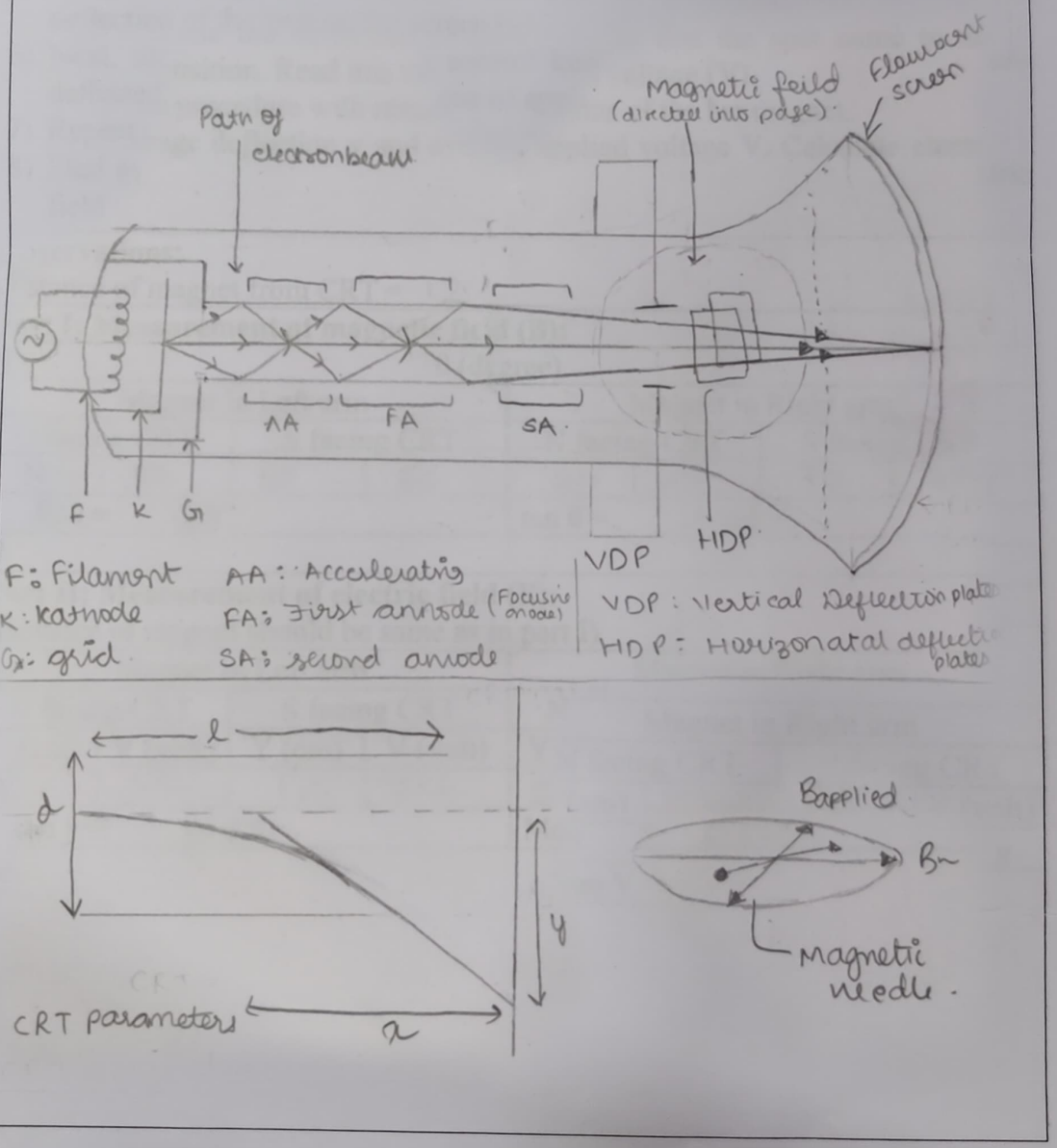
Expt. No	9	e/m ratio of electrons		Date:	
Batch:	A3	Roll No:	16010121051		
Meet gala				(Marks & Signature of Faculty I/c)	

Aim:	To estimate e/m ratio (specific charge) of electrons using Thomson's method
Apparatus:	Thomson's apparatus (CRT with power supply and controls, bar magnets, magnetometer etc.)

Diagram:



Procedure:

1) Keep the magnetometer at the centre of wooden frame in the slot. Ensure that there is no magnet or magnetic field around. Let its needle come to rest along N-S direction. Once it comes to rest, the pointer will be along E-W direction. Rotate arms of wooden frame to align along the E-W direction. Rotate dial of magnetometer and get 0-0 of the dial to coincide with the pointer. This is "tan A" position. Do not disturb the position of wooden frame after this.
2) Note down deflections (θ) of magnetometer needle by keeping a bar magnet at a suitable distance (say 10-15 cm) from the needle in one of the arms of the wooden frame.
3) Take readings by reversing the polarity of magnet and placing the magnet in other arm of the wooden frame.
4) Find average of all these readings. Find tan θ. Calculate magnetic field (B).
5) Replace magnetometer with CRT. First, keep applied voltage to be zero. Keep bar magnet at the same distance as in earlier case. Note down deflection of the spot on the screen (y).
6) Next, increase the deflection control knob so that the spot come to un-deflected position. Read this value of applied voltage (V).
7) Repeat the procedure with remaining positions of the bar magnet.
8) Find average deflection y and average applied voltage V. Calculate electric field (E).

Observations:
Distance of magnet from CRT = 12 cm

Part I: Measurement of magnetic field (B):

θ (degree)							
Magnet in Left arm				Magnet in Right arm			
N facing CRT		S facing CRT		N facing CRT		S facing CRT	
52	54	69	66	44	47	70	70
Mean θ = 59°				tan θ = 1.664			

Part II: Measurement of electric field (E):
(distance of magnet should be same as in part I)

Magnet in Left arm				Magnet in Right arm			
N facing CRT		S facing CRT		N facing CRT		S facing CRT	
Y (cm)	V (volt)	Y (cm)	V (volt)	Y (cm)	V (volt)	Y (cm)	V (volt)
0.7	6.3	1	7.1	1	7.1	0.7	6.8
Mean y = 0.85				Mean V = 6.825			

Formulae:

$B = B_H \tan\theta$

$\varepsilon = \frac{V}{d}$

$\frac{e}{m} = \frac{y \times \varepsilon}{\lambda \times l \times B^2}$

Symbols:

B: Magnetic field intensity due to bar magnet
l: Length of deflection plates
B_H: Horizontal component of Earth's Magnetic Field.
θ: Deflection of magnetometer needle.
ε: Electric field intensity
V: Compensating voltage
d: Distance b/w deflection plates of CRT
e/m: Charge to mass ratio of electrons
y: Deflection of spot due to magnetic field.
λ: Distance of CRT screen from deflection plates

Data:

Horizontal component of Earth's magnetic field B_H	4.2×10^{-5} W/m^2
Distance between deflection plates d	10 mm = 0.01 m
Average distance of screen from deflection plates *x*	130 mm = 0.13m
Length of deflection plates *l*	40 mm = 0.04 m

Calculations:

$\tan\theta = 1.664$, $y = 0.85\text{ cm} = 8.5 \times 10^{-3}$ m, $V = 6.825$

$B = B_H \tan\theta = 4.2 \times 10^{-5} \times 1.664 = 6.98 \times 10^{-5}$

$\varepsilon = \frac{V}{d} = \frac{6.825}{0.01} = 682.5$

$\frac{e}{m} = \frac{y \times \varepsilon}{\lambda \times l \times B^2} = \frac{8.5 \times 10^{-3} \times 682.5}{0.13 \times 0.04 \times (6.98 \times 10^{-5})^2}$

$e/m = 2.289 \times 10^{11}$

Result:

Estimation of charge to mass ratio for electrons (e/m): 2.289×10^{11}

Further Work:

Use of electron beam in electron microscopes.