E 23 050 P08

6

DEPARTMENT OF PHYSICS
OSAKA IMPERIAL UNIVERSITY.

DATE
NO.

Efficiency of Pb Counter

~~[illegible]~~.

i) Photoelectric Effect.

$\boxed{\gamma = 1}$

$\tau = \cancel{10^{1.5} \times 0.23} = 31.62 \times 0.23$

31.62
0.23
10486
6324
7.27726

316
179
2814
2212
316
82) 56.534 (677
492
633
574
594
574
200

$\tau_K = 10^{1.5} \cdot \frac{NZ\Phi_0}{Z} = 31.62 \times \frac{1.79}{82}$

$= 0.677$

0.846
8) 0.677
64
37

$\tau_p = \frac{5}{4} \tau_K = \underline{\underline{0.85}}$

$R_p = \underline{\underline{3.7 \times 10^{-2} \text{cm}}}$ in Pb

$\left(\frac{0.165}{2.7} \text{cm} = 0.6 \text{ mm}. \text{ in Al} \right)$

0.85
3.7
595
255
3145

$\tau_p R_p =$ ~~2.2%~~ 3.14%

$\boxed{\gamma = 2}$ $\tau_p = 0.210$ ($\tau_{\text{total}} = 0.$[illegible]$80.$)

$R_p =$

DEPARTMENT OF PHYSICS
OSAKA IMPERIAL UNIVERSITY.

DATE..................
NO.....................

Range of Fast Electrons in Lead

$$-\left(\frac{dE}{dx}\right)_{col} = NZ\phi_0 \cdot \frac{3}{4}\mu \frac{1}{\beta^2}\left[\log \frac{\mu\beta^2 \cdot 2\mu\beta^2}{(1-\beta^2)I^2Z^2}\right.$$

$$\left[\log \frac{(E-\mu)E^2\beta^2}{2\mu I^2 Z^2} + \left(\frac{\mu}{E}\right)^2\right]$$

~~β~~ ~~$\frac{E}{\sqrt{1-\beta^2}}$~~ $E = \frac{\mu}{\sqrt{1-\beta^2}}$ $\qquad \beta = \sqrt{1-\left(\frac{\mu}{E}\right)^2}$

$$-\left(\frac{dE}{dx}\right)_{coll} = NZ\phi_0 \cdot \frac{3\mu\varepsilon^2}{4(\varepsilon^2-1)}\left[\log \frac{(\varepsilon-1)\varepsilon^2(\varepsilon^2-1)\mu^2}{2I^2Z^2\cancel{\varepsilon^2}\varepsilon^2} + \frac{1}{\varepsilon^2}\right]$$

$$= NZ\phi_0 \frac{3\mu\varepsilon^2}{4(\varepsilon^2-1)}\left[\log(\varepsilon-1)(\varepsilon^2-1) + \log\frac{\cancel{2}\mu^2}{2I^2Z^2} + \frac{1}{\varepsilon^2}\right]$$

$I = 13.5$
$\mu = 5.1 \times 10^4$
$Z = 82$.
2

~~log~~
I^{-2}
μ^{2}
Z^{-2}
2^{-1}

log
5.97018
18.42072
$\bar{2}$.8636
9.1866
~~-0.69315~~
~~$\bar{6}$~~.
$\bar{1}$.30685
12.74795

$\log\frac{\mu^2}{2I^2Z^2} = 12.7479_5$
$= 12.748$

4.4067
2
-8.8134
$\bar{9}$.1866

3.9318
2
7.8636

2.30259
8
18.42072

1.32176
0.69315
2.01491
2
4.02982
$\bar{5}$.97018

DEPARTMENT OF PHYSICS
OSAKA IMPERIAL UNIVERSITY.

DATE

NO.

$$-\left(\frac{dE}{dx}\right)_{coll} = 1.79 \times \frac{3\mu\varepsilon^2}{4(\varepsilon^2-1)}\left[\log(\varepsilon-1)(\varepsilon^2-1) + 12.748 + \frac{1}{\varepsilon^2}\right]$$

$$-\left(\frac{dE}{dx}\right)_{rad} = N\frac{Z^2 r_0^2}{(137.3)^2}\cdot\mu\varepsilon \quad \frac{\Phi_{rad}}{\Phi} = 12.74\cdot\mu\varepsilon\,\frac{\Phi_{rad}}{\Phi}$$

$$\text{range} = \int_0^E \frac{dE}{-\left(\frac{dE}{dx}\right)_{coll} - \left(\frac{dE}{dx}\right)_{rad}} = \int_0^{\varepsilon} \frac{d\varepsilon}{-\left(\frac{d\varepsilon}{dx}\right)_{coll} - \left(\frac{d\varepsilon}{dx}\right)_{rad}}$$

ε	0.01	0.1	1	10	100	1000	10000
$\frac{1}{-\left(\frac{d\varepsilon}{dx}\right)_{rad} - \left(\frac{d\varepsilon}{dx}\right)_{coll}}$	0.00385	0.0154	0.0435	0.0244	0.00488	0.000513	0.0000513

$\int_0^\pi \cos x \sin x \, dx$

$\approx \frac{1}{2}$

DATE

NO.

$24 \times 12 = 48 + 24 = 288$

$288 \times 15 = 1440 + 288 = 4320$

-0.

$\gamma = 10$:

$\tau_M = 0.24 \ \mathrm{cm}^{-1}$ $\varepsilon_{mean} = 4 \pm 1$.   range $R_M = 0.12$ cm

$\mathrm{eff}_M = 2 \times \tau_M \times R_M = \cancel{0.144}$ 0.0576 $\cancel{\approx 14\%}$ $\approx 5.8\%$

$0.0144 \times 4 = 0.0576$

$\tau_p = 1.2 \times N Z \phi_0 \frac{1}{2}$ $R_p \approx 0.3$ cm

$= \frac{1.2 \times 1.79}{82} = 0.026 \ \mathrm{cm}^{-1}$

4.35%

$14.5 / 3$ 4.35

$1.79 \times 0.6 = 1.074$

$41) \ 1.074 \ (0.026$ 82 254

$\mathrm{eff}_P = 0.026 \times 0.3 = 0.0072 = 0.7\%$

$\tau_C = 0.12 \times 1.79 = 0.21 \ \mathrm{cm}^{-1}$

$R_C = 0.3$ cm

$1.79 \times .12 = 358 + 179 = 0.2148$

$\mathrm{eff}_C = \beta \times 0.21 \times 0.3 = \beta \times 0.062$

$\beta = \frac{3}{4}$ $= 0.046\% = \cancel{4\%}$ $\approx 4.6\%$

$\mathrm{eff}_{total} \approx \cancel{10\%}$ $11\% \sim 8\%$

eff_M を 2 にすると

eff_M を 1.5 にすると

9.6%

$\boxed{10\%}$

$\gamma = 2$:

$\tau_p = 0.20 \ \mathrm{cm}^{-1}$ $R_p = 0.06$ cm

$\tau_p R_p = 0.012 = 1.2\%$

$1.79 \times .31 = 179 + 537 = 0.5549$

$\tau_c = 0.31 \times 1.79 = 0.55 \ \mathrm{cm}^{-1}$

$\cancel{R_c =}$

$\varepsilon_{max} = 1.6 \pm 1$

$\varepsilon_{mean} = 1.1 \pm 1 \rightarrow R_c = 0.04$

$\tau_c R_c = 0.55 \times 0.04 = 0.022 = 2.2\%$

$\mathrm{eff}_{total} = 1.2 + 2.2 = \boxed{3.4\%}$

DEPARTMENT OF PHYSICS
OSAKA IMPERIAL UNIVERSITY.

DATE
NO.

$\gamma = 5:$ $\tau_M = 0.08\ \mathrm{cm}^{-1}$ $\varepsilon_{mean} = 1.5+1.$ $R_M = 0.045$

$\mathrm{eff}_M = \beta \times \tau_M R_M = \beta \times 0.0036$

$\beta = \cancel{1}5$ $= 0.0054$ $= 0.54\%$

383

$\tau_p = 0.0\overset{4}{5}\ \mathrm{cm}^{-1}$ $\varepsilon = \overset{5+1}{\cancel{4+1}}.$ $R_p = 0.14\ \mathrm{cm}$

$\tau_p R_p = 0.00\overset{56}{70}$ $= 0.\overset{6}{\cancel{7}}\%$

$\tau_c = 0.35$ $\varepsilon_{\cancel{max}} \overset{<}{\cong} 5+1.$ $R_c = 0.16$

$\varepsilon_{mean} \cong 4+1$ $R_c = 0.12\ \mathrm{cm}$

$\tau_c R_c = 0.042$ $= 4.2\%$

$$\begin{array}{r} 35 \\ 12 \\ \hline 70 \\ 35 \\ \hline 420 \end{array}$$

$\mathrm{eff}_{total} = 5.4\%$ $= \boxed{5\%}$

$\gamma = 20;$ $\tau_M = 0.5\ \mathrm{cm}^{-1}$ $\varepsilon_{mean} \geqq 1+9$

$R_M \gtrsim 0.3\ \mathrm{cm}$

~~$\tau_p = 8.36 \times 0.23 \times 10^{-2}$~~

$\tau_M R_M = 0.15$ $\mathrm{eff}_M = 15\%$

$\varepsilon = 21$

$$\begin{array}{r} 8.36 \\ 0.23 \\ \hline 2508 \\ 1672 \\ \hline 1.9228 \end{array}$$

$\tau_c = 0.15\ \mathrm{cm}^{-1}$ $\varepsilon_{\overset{\cancel{mean}}{\scriptstyle{lax}}} \gtrsim \cancel{1}20$

$R_M \gtrsim 0.5\ \mathrm{cm}$ $\underline{0.3}$ 0.75

$\tau_M R_M = 0.045\ \cancel{\mathrm{cm}}$ $\mathrm{eff}_c = 4.5\%$ 0.06

$\tau_p = \cancel{0.0}0.012$

$R_p = 0.54$

$$\begin{array}{r} 0.54 \\ \cancel{0.019} \\ \hline 486 \\ 54 \\ \hline 0.01026 \end{array} \qquad \begin{array}{r} 0.54 \\ 0.0012 \\ \hline 108 \\ 54 \\ \hline 0.006\cancel{4}8 \end{array}$$

$\mathrm{eff}_{Total} \gtrsim 20\%$

0.3

$\gamma = 200$ $(10^8 eV)$

$\tau \simeq 1.16\ cm^{-1}$.

$R = 0.3$

$eff \cong 35\%$