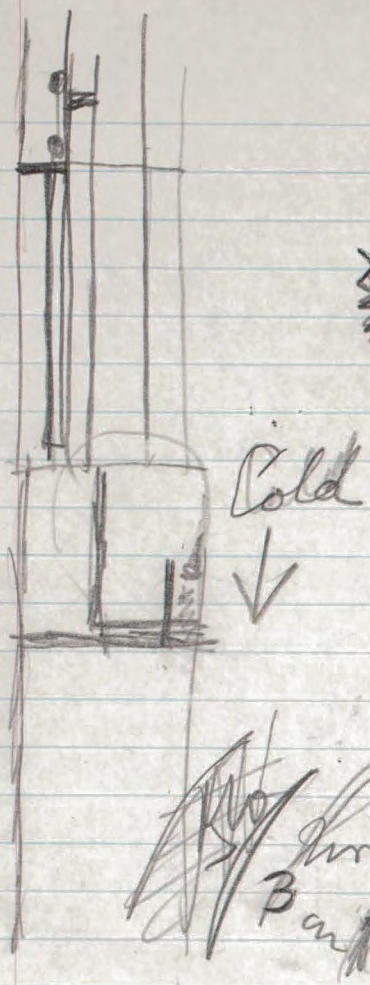
	Mt.	Boil	~~cl. [illegible]~~ resist	W
U	1150C°	(4200)	Micrahm cm	
Pu				
Ta	2977	—	71[1500]; 102[2500]	4.19
Mo	2610	4700	46[1500] 77[2500]	4.2
Ni				
Os	2700	5500	9.5[20]	4.55
Cu				
Al	660		7.30[400]	
Ag	960	2210	9.3 [1100]	
W	3370C	5900C	65 [2000]	4.52
Zirc.	1845	(4900)		
Caes.	29.7	700		
Cu	1083	(2590)	2.93(200)	
Gold	1063	(2950)		
Ruth	(2500)	(4900)		
Va	750	(3350)		
Zi	1845	(4900)		4.21
Th	1850	(3500)		3.35
C	3550	4200	1100[2000]	

Working W, | Ta solub. in U or Pu
~~[illegible]~~ UC_2 sol in ZnC_2



$15 \times 50 \; x = 10^4$

$750 \, x = 10^4$

~14.3 amps / cm² for 10KW units

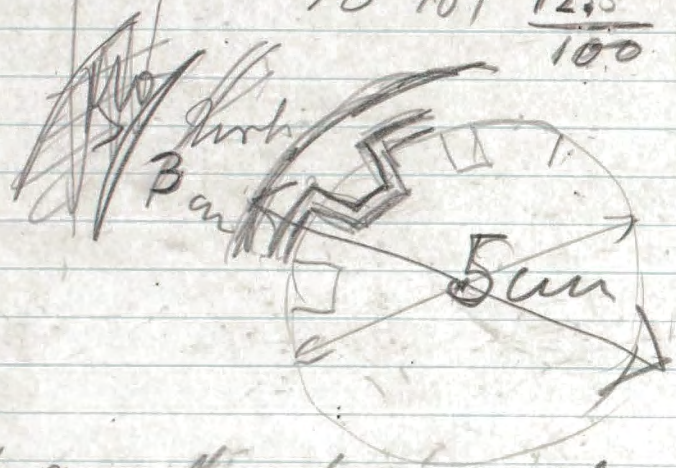
$H_0 = \frac{KW}{15 \times 20} = \frac{kW}{300} = 30$ gauss

for 10 KW / per unit

$H_0 = 300$ gauss for 100KW / per unit

$10 \; 10^4 \; \frac{12.5}{100} \; \frac{1}{20} \; \frac{1}{100} \; cm^2 = \frac{Q}{B}$

$\frac{125}{20} = 5 cm^2$



but cannot be for "res" = 50 (optim)

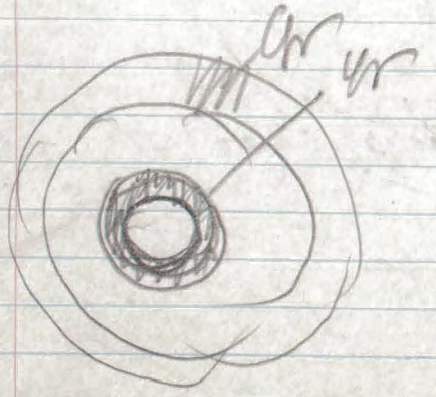
50 cm²

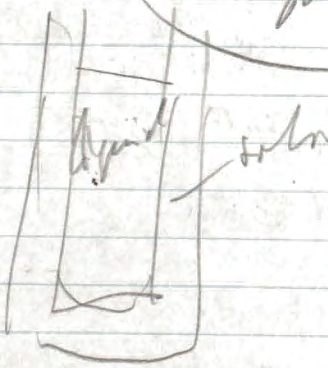
$2\pi (R_2 - R_1)^2 = 60$

$(R_2 - R_1)^2 = 10$

$R_2 - R_1 \approx 3$ cm

Ruthenium what price





Melting Points

	mp	bp
Cr	1850	2430
Zr	2443	5300
Pt	1769	4500
Rhe	3145	=
Rhod	1960	4500
Ru Th	2500	(4900)
Ta	2977	—
Th	1850	3500
W	3380	(6700)
Va	1750	
Zi	1845	
Ti	1730	3260

	Low melt		High boil
3.75	Ba	710	(1800)
1.54	Ca	850	1690
2.63	Sr	770	(1360)
1.84	Be	1284	2967
2.7	Al	660	(2500)
6.68	Sb	630	(1640)

Melting points 1000 or less
above vapour press at 1000 ≈ two Atm

Bi	271	1560
Cd	(800)	(2500)
Co	1083	2590
Ga	29.8	2070

Heat conduction

4

0.0004 Argon. Cal.

$2.5 \; 4 \cdot 10^{-5} \; \frac{\text{cal}}{\sqrt{3}} / c^{\circ} \; \frac{1}{d} = 25 \text{ cal} \approx 20 \text{ watt}/\text{cm}^2$

10^{-5} cm 1 Atm for A

10^{-2} cm $\frac{1}{1000}$ Atm

$\frac{1}{22000} \frac{N_1}{N_0} v \quad N_0$

$e^{-\frac{W}{6000}}$ / 5 cm

$e^{-\frac{W}{RT}}$

$e^{-\frac{W}{R(T+\Delta T)}}$

$e^{\frac{W}{RT}\frac{\Delta T}{T}}$

$e^{+\frac{24}{T}\frac{\Delta T}{T}}$

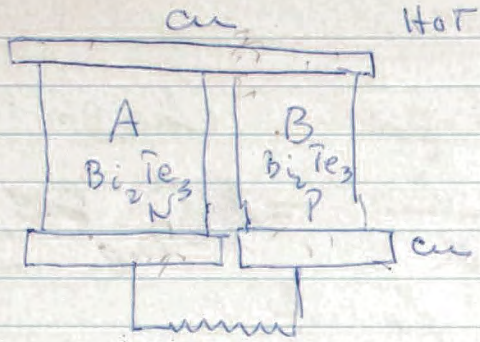
$\left(1 + \frac{1}{1000}\right)^{100}$

Compute cond of argon

$\frac{1}{3} v \cdot \frac{10^{-5}}{22000} \frac{3}{2} k \quad \frac{1}{\text{cm}} = 10^{-5}$ Atm

$= \frac{1}{6} \frac{4 \times 10^4}{2.2 \, 10^4} 10^{-5} \frac{3}{2} 600 =$

$\frac{1}{3} \frac{4 \, 10^4}{2.2 \, 10^4} 10^{-5} \frac{3}{2} 2 = \frac{4}{6.6} 3 \, 10^{-5} = \boxed{2 \, 10^{-5}}$



10^2 ohm^{-1} cm^{-1}

$$\frac{\alpha^2 \sigma T}{K \sigma}$$

$\frac{200\ \mu v}{oC}$

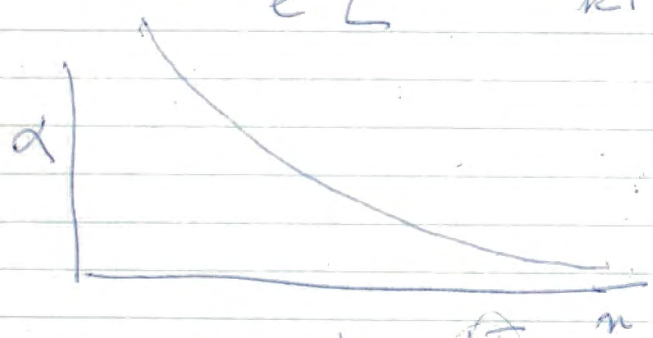
$\frac{600\ °C}{120{,}000}$ 200 10^{-6}

0.12 Volts

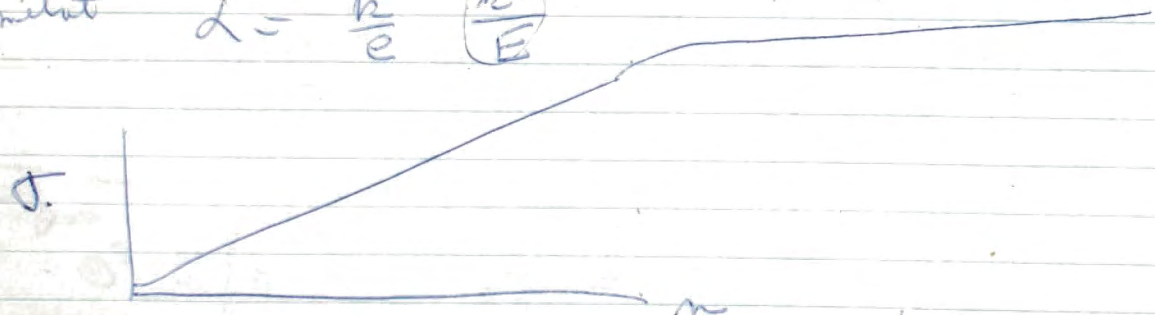
12%

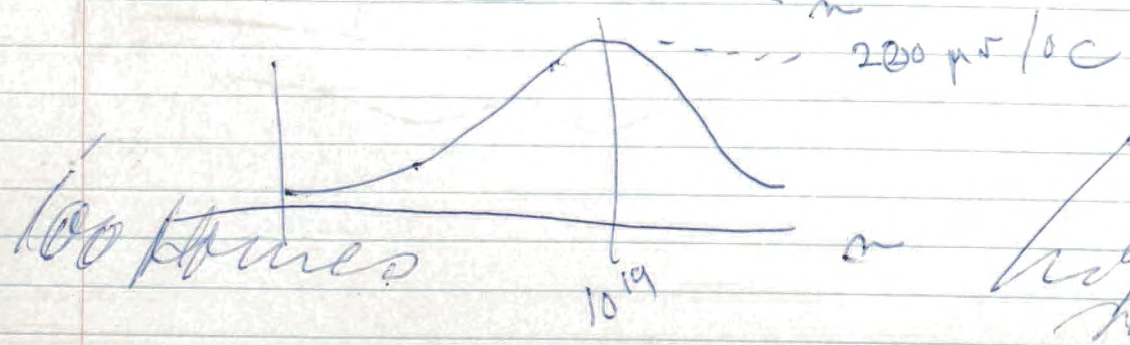
S.C

$$\alpha = \frac{k}{e}\left[2 + \frac{\Delta E}{kT}\right]$$



mihat $\alpha = \frac{k}{e}\left(\frac{kT}{E}\right)$





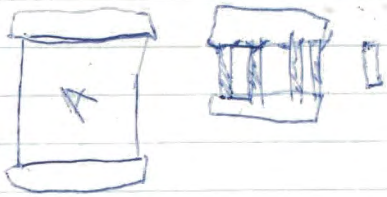
100 Homes

higher? res - Hy

Marg. Beth (Sterns)

Valney Wolson

RCA
Los Alamos
Hal Lewis
Jaffe Cook



Gl. 91686
Kerst

1230

Ted Taylor

Hal Lewis
Rosenbluth
Kerst

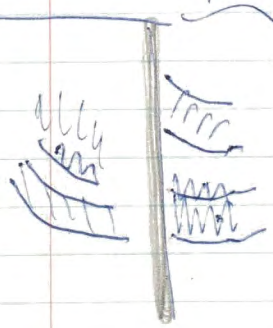
Dove Rose
Fortescue (Peter)

Simnad
Duffield

10^{-3} atm 1 cm

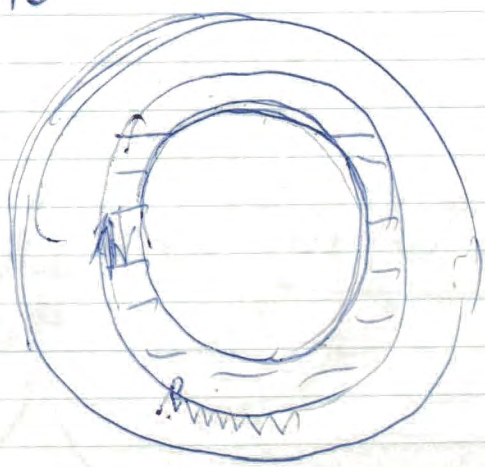
1 atm $\alpha = 10^{-5}$

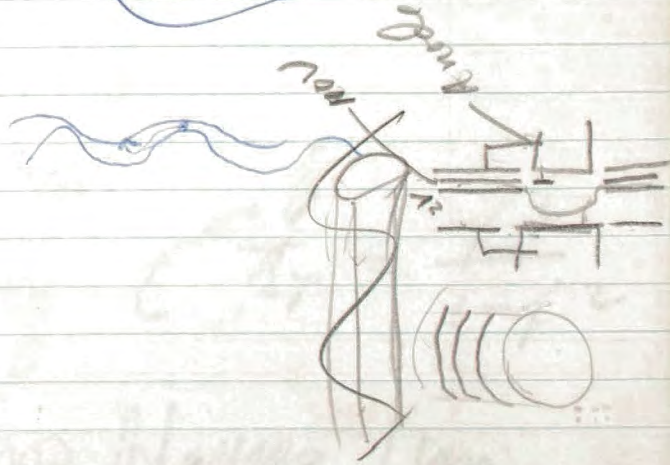
cal



$\frac{1}{10}$ 10^{-3} atm 1 cm

$\frac{1}{100}$ cm





H

Argon ~~0.0000~~ $\frac{4 \times \sqrt{10}}{\sqrt{3}}$

$8\,10^{-5}\ 10^{3}\ 10^{2} = \frac{8\,\text{cal}/\text{cm}^2}{30\,\text{watt}/\text{cm}^2}$

f fraction ion $\frac{\text{ion}}{\text{ion} \times \text{atom}}$

$$\frac{f^2}{1-f^2} = \frac{3 \times 10^4}{P\,m/m\,(T_i N_0)} \left(\frac{T}{3000}\right)^{5/2} e^{-\frac{3.8}{RT}\frac{\text{volts}}{(\text{volts}}}$$

total pressure

or 2

$$\sigma = \frac{10^{-12}}{(eV)^2}\ \text{cm}^2$$

10^{12} el/cc $h = 1$ cm

$(m k T)^{3/2}$

$$\frac{2kT}{P} \frac{(2\pi\, m k T)^{3/2}}{h^3} e^{-\frac{eV}{kT}} = \frac{f^2}{1-f^2}$$

$h = 6\ 10^{-27}$

Los Alamos 1 cm
Distance

gain $\frac{1}{2}$ i Watt

at 10 Amps/cm² ~~5 Volt~~ 5 Watt

at 30 " " 15 Watt

at T_{acc} = 2300 loss (2.43 − 1) 18 Watt = too much!

$$\frac{Q_1 - Q_2}{Q_1} = \frac{T_1 - T_2}{T_1}$$

Heat cond p. Coe

0.0002 1000°C 0.2 cal per cm² for 2 cal for ~~[illegible]~~ diff 1000°C

$\frac{1}{2}\ \frac{3}{2}\ \frac{1}{10}$ | $\frac{d\ v}{22000}\ \frac{N}{N_0}\ \frac{3}{2}\ \frac{k\ N_0}{R}\ \frac{1}{d}$ | $\frac{1}{1000}$ cm/sec 1 Atm

$\frac{1}{10}\ \frac{1}{10}$ | $\frac{3}{22}\ \frac{3}{2}\ \frac{600}{40}\ v$ = 1/10 Atm $\frac{1}{1000}$ cm

$\frac{3}{44}$ 60 = 3 cal

CO_2 = 32 / 12

3×50 0.00017 $\frac{3}{2}$

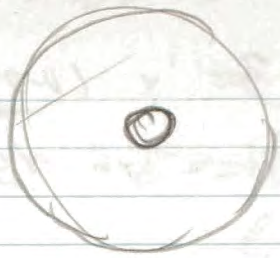
$\frac{1}{100}$ Atm

$4\ 10^{-5}$ $4\ 10^{-2}$ cal ~~40 cal~~ 4 cal $4\ 10^{-5}$

$\frac{1}{100}$ cm } $\frac{1}{100}$ Atm } i = 30 | 100 Watt loss at cathode

$\boxed{\frac{1}{100}\ \text{Atm} \quad 10^{-2}\ \text{cm}}$

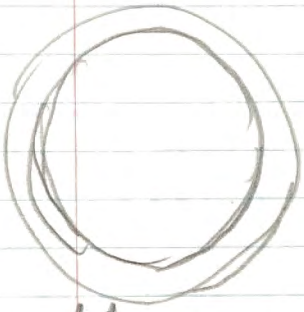
Radiation



T_1

Lower by factor 4 T_1 lowered by 120°C°

Abs/cm² of inside $\frac{\text{Block at } T_1}{30}$ (or $\frac{\text{Block at } T_1}{4}$ if Wooded)



If both coated

$\frac{\text{Block}}{4}$ at T_2

H depends only on i and l

$$H = \frac{1}{10}\frac{il}{2}$$

Radiation $A\,4T^3\Delta T = \frac{AT^4}{108}$

$4\Delta T = T$

$\Delta T = \frac{T}{4\times 8} = \frac{T}{50} = \frac{2000}{40}$

T_{abs} 2000 = 90 Watt/8 = 11.2 Watt/cm²

$T_{abs} = 2300$ = 1.7 × 11.2 Watt/cm²

= 19 Watt/cm²

$T_{abs} = 3000$ 100 Watt/cm²

Atomic hydrogen welding

½ Volt higher at 4 Volt makes ½ in T

½ = makes increase in Radiation factor 2.43

$\frac{20\,cm^2}{10}$ $\times$ 0.3 $\times$ 1000 cal

$4 \frac{200\,000}{3 \times 100}$ watts $= 2.6\ 10^5$ Watt $= 260$ KWatt

2.6 K Watt

Transition length 10 cm

Imagination

1 mfm $\times$ 200 mm $= 200$ (mfm)^2

10 cm length 1 Volt $=$ $I_{worte} = 2000$ Amp

upper end only $I_{max} = 2\pi r \frac{530}{2}$

5300

1 Volt $H\rho = 34$ mfm for $H = 25$ Gauss

1/6 Volt $H\rho = 13.6$ mfm

$H = 25$ Gauss $\rho = 0.5$ mfm

$\frac{n}{l}\frac{v}{3}\Delta t = 30 \times 3\,10^9$ el. (30 Amp)

Assume v corresp 1 Volt $= 2\,10^{-3}\ 3\,10^{10}$

$\frac{1}{3} n \frac{6\,10^7}{1} \frac{1}{20} = 10^{11} \frac{1}{5} 10^{10} = 6\,10^7$ cm/sec $= 2\,10^{20}$

$n\ 10^6$ cm/sec $= 2\,10^{20}$

$n = 2\,10^{14}$

mean free path in Cu

$\cancel{10^{14}\ 10^{-14} = \frac{1}{20}}$

$n\sigma = 2$

mean free path $\frac{1}{2}$ cm if $N = n$

could $\frac{1}{10}$ be Cu ions?

1 unit 10 KWatts

$r = 3$ cm $\quad i = 53$ Amps/cm² for $l = 10$ cm

$2\pi r \approx 19$ cm² $\quad i = 26$ Amps/cm² for $l = 20$

$i\,l = 530$ Amp

$$\left\{ \begin{array}{l} \cancel{H} \; \mathcal{J}_{max} = \cancel{\ldots} \; 2\pi r \dfrac{530}{2} \\ \cancel{l = 10\text{ cm}} \\ \bar{\bar{\mathcal{J}}} = 2\pi r \dfrac{530}{4} \end{array} \right.$$

$$H_{max} = \frac{53}{2} = \underline{26 \text{ Gauss}}$$

$$H_{max} = \frac{1}{2\pi r} \frac{1}{2} \frac{\text{Watts}}{\text{Volts}} \frac{1}{10}$$

For given watts per unit H is inversely prop to r

l could be made longer for lower i if Watts fixed

$l = 20$ cm $\quad \bar{\bar{\mathcal{J}}} = 2\pi r \dfrac{530}{4}$

Copper $= F$ cm²

$$\frac{1}{10} \frac{1}{20} \frac{1}{F} \frac{1}{100} \frac{19 \times 530}{4} = \frac{1}{10} \text{ Volt}$$

$$F = \frac{1}{20} \frac{10^4}{100 \times 4} = 1.2 \text{ cm}^2$$

corresponding W wall $\quad 20 \times 1.2 = 22$ cm²

1 cm wall $\quad r = 3$ cm

heat transfer $1.3\,10^{15}\,v$

$v = 218\ \text{cm/sec} \times 3 = 660\ \text{cm/sec}$, [at 3000 = T abs]

$1.3\,10^{15} \times 660 \times 10\,\frac{3}{2}\,k\,T \qquad k = \frac{R}{6\,10^{23}}$

$= \frac{3}{2}\,\frac{1.3 \times 10^{15} \times 660 \times 10 \times 600 \times 10}{6 \cdot 10^{23}} =$

$\frac{2 \times 40 \times 10^{21}}{6 \cdot 10^{23}} = \frac{8}{60} = \frac{1}{10}\ \text{cal/cm}^2$ $\boxed{\text{1 mm gap}}$

Radiation per cm² at $T_{abs} = 2000$ — 90 Watts black

and with 0.03 reflect — 3 Watts/cm²

1 Amp. ~~Useful 0.7 Watt~~

Total 3 Watts

\+ 1 Watt

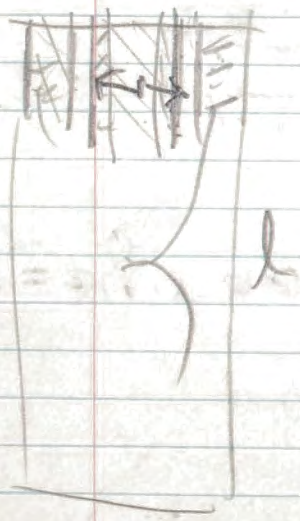
Wilson 0.7 Volt

1.3 Amp.

$1.3 \times 5.2 = 7$

$+3$

10



$i > 1$ Amps

$i\,2\pi r\,l\,V = \text{Watts}$ $\begin{cases} 1000\ \text{KWatts} \\ 10000\ \text{KWatts} \end{cases}$

1 Unit $\begin{cases} 10\ \text{KW} \\ 100\ \text{KW} \end{cases}$ — 100 Units

$i = 1$ Amps $\Downarrow$ $i = 30$ Amps

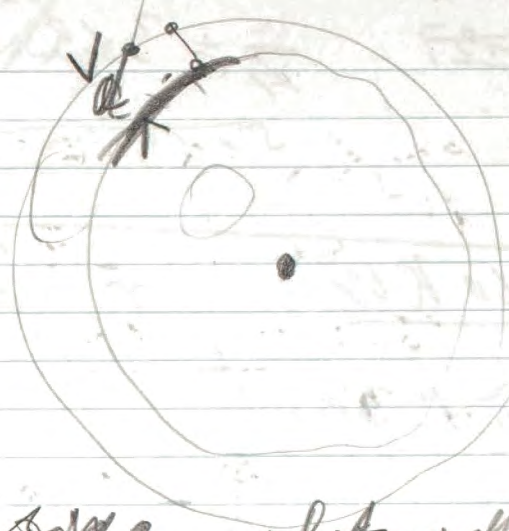
$l = 10$ cm

$2\pi r i = 1000$

$r i = \frac{1000}{2\pi} = 160$

$\frac{\sigma 4\pi r^2}{r}$

$4\pi d\sigma$ is Pot



The minimum size of Anode:
Ohm loss determined !!

heat transport

corresponds to R

$\frac{v_x}{3} \frac{N}{N_0} \frac{3}{2} \frac{K N_0 \, 22000}{22000} \frac{1}{1000}$

10^4

$r = 10^4$

$\frac{10}{22000}$ cal / grade

$\frac{1}{20000}$ cal / grade

$\frac{v}{3} \frac{3}{2} kN$

$\frac{1}{10} N 10^{-16} = 1$

$N = 10^{17}$

$5.6 \; 10^{-6}$ cm $\quad$ 1 atm $\quad$ $\frac{1}{1000}$ atm $\quad 5.6 \; 10^{-3}$ cm

$\sigma = (3.42)^2 \pi \; 10^{-16}$

$\rho = \frac{1}{x}$ atm

$x \times 5.6 \; 10^{-6}$ cm $= \frac{1}{10}$ cm

$x = \frac{10^6}{56} \approx 12 \; 10^4$

$N = \frac{6 \; 10^{23}}{22{,}400 \times 2 \; 10^4}$

$N = \frac{6}{4} = 1.3 \; 10^{15}$

$x = 1$ mm

1 Volt ||

$\frac{v}{H} = 2\,10^{-3} \times 3\,10^{10} = 6\,10^{+7}$ cm/sec

5×10 cm/sec $50 = 25 \times 10^{6}$

Try 10 KW $\quad r = 3 \quad i = 30$

$10^4 = 2\pi r\, 30 \cdot l$ $\quad l = \frac{10^4}{60} = 166.5$ cm

$2\pi \cdot 30$

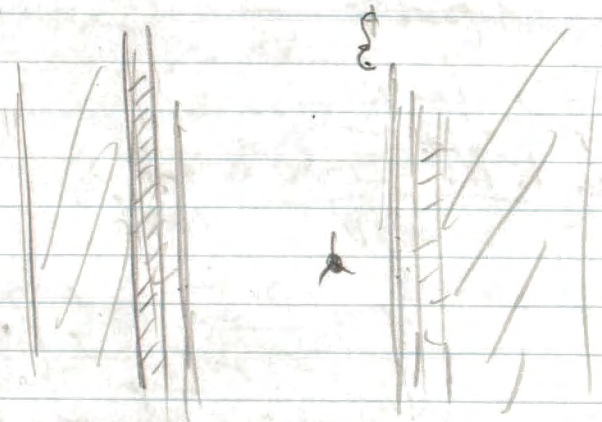
600

10000 Amp $\quad M = \frac{10^4}{2 \times 3 \cdot 2\pi \cdot 10} = \frac{10^4}{400} = 25$ Gauss

Ohmic Loss: $\frac{1}{4}$ Watts / Volts $\quad$ Res. $= \frac{1}{10}$

$\text{Res} = \frac{\frac{1}{2} l}{100} \frac{1}{\pi r 100}$ $\quad \frac{1}{20} \simeq \frac{1}{100} \frac{1}{100} 20 \frac{1}{10}$

$= \frac{1}{20}\, 10^{-4}$



$\frac{1}{2} 2\pi r i \cdot l = \mathcal{Y}$ (for H)

$H = \frac{1}{20} i l$

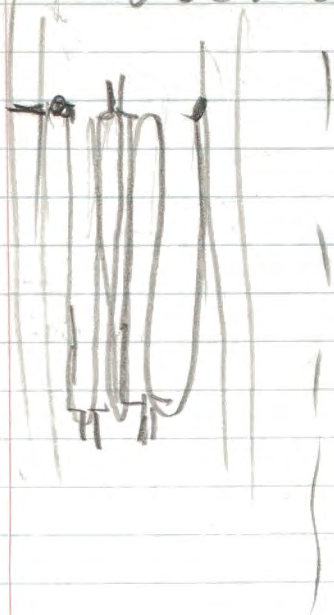
$\mathcal{Y}_{max} = \frac{1}{2} i l 2\pi r$

Watts $= i l$ Volts $2\pi r$

$\frac{1}{2}$ Watts / Volts $= \mathcal{Y}_{max} 2\pi r$

$\frac{1}{100} = N$

Double Imagination



Cancels
of small gap
and Lea for
real work fn
at cathode

$y = 40 \times 30 = 10^3$

$H = \frac{100}{2\pi} = 10$

Hg 1 Volt = 3.3 mm

Min current density 1 Amps
~~Min~~ ~~Ar~~ Anod ~~A = 1 cm~~ r =
current density at surface of Anode = i
Current at ~~anode~~ upper and lower
end of unit

$y > \frac{1}{2} 2\pi r l$ | $yV > 2\pi r l$ ~~watt~~

$y = \frac{1}{2} 2\pi r l\, i$ | $yV \approx 2\pi r\, i\, l$ watt

$\frac{\text{Watt}}{\text{Volt}} = 2\pi r i$ (10) min

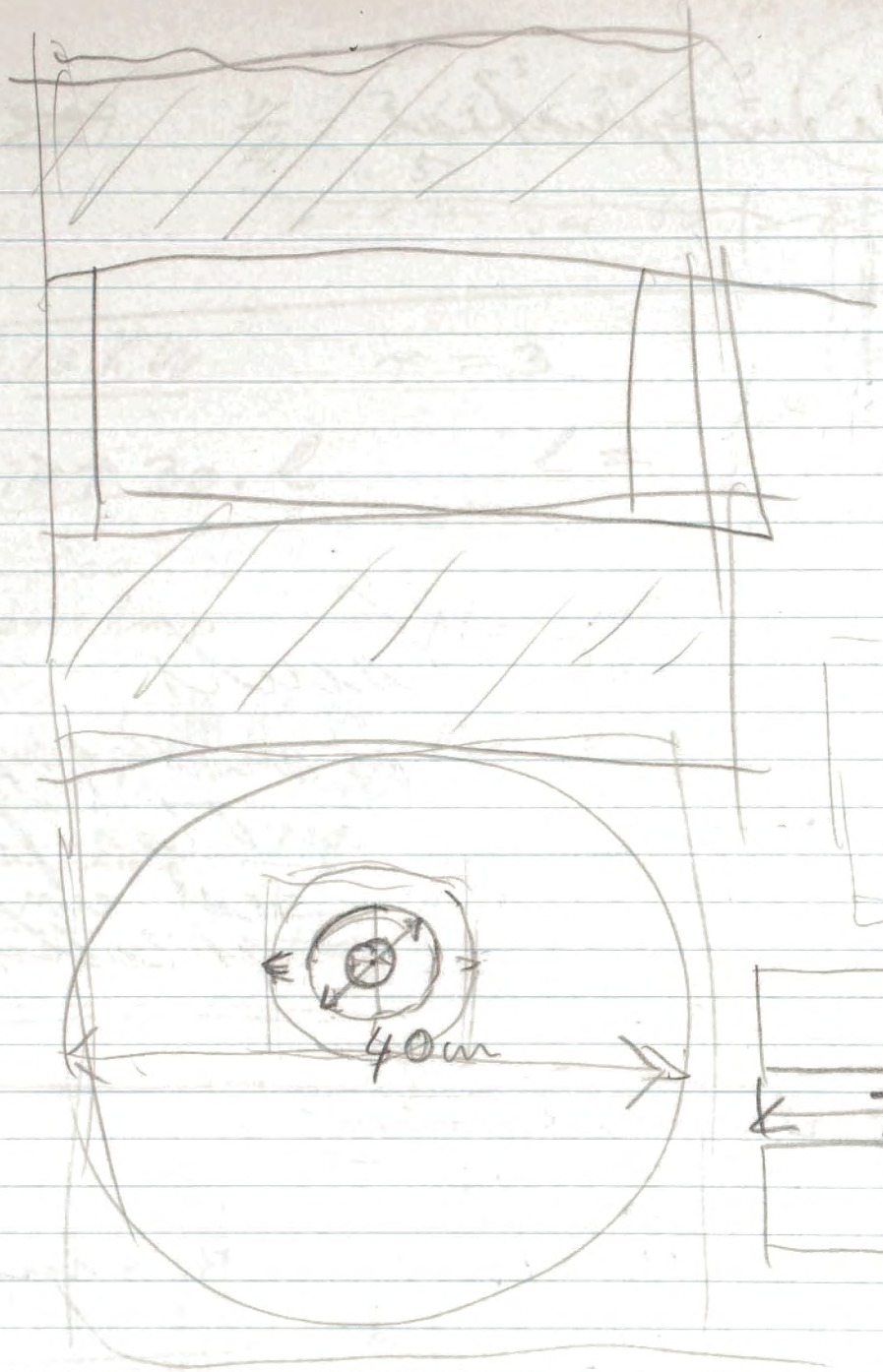
$r < \frac{1}{2\pi} \frac{\text{Watt}}{\text{Volt}} \frac{1}{i} \frac{1}{10}$

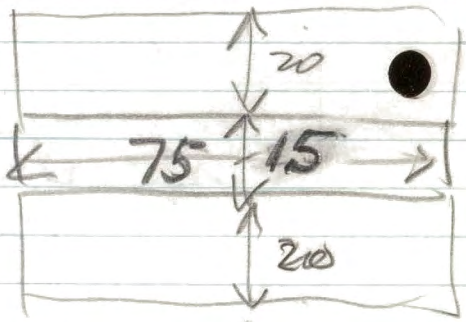
$r = 1$, $l = 20$ } $y > 120$ Amp

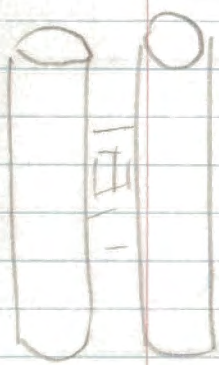
$y_0 \cong$ ~~Watt~~ " Watts $\times \frac{1}{\text{Volts}}$ $\frac{1}{2}$ | 10 kW

$r < 3$ cm

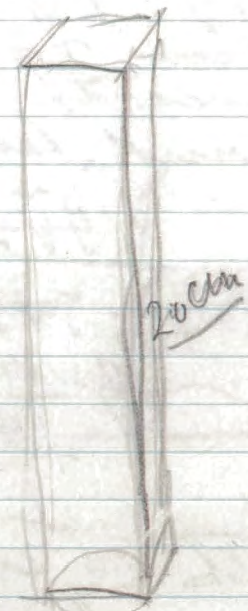
$H = \frac{1}{2} \frac{\text{Watts}}{\text{Volts}} \frac{1}{2\pi r} \frac{1}{10}$







30 x 4 x 20
3,000 watt
3KW



$2 \frac{0.1 \times 1000}{10}$ cal
10cal/sec
100 watt
20 cal 80 watt

$\frac{1}{2}$ m²

300 watt

100 cm² 30 Amps

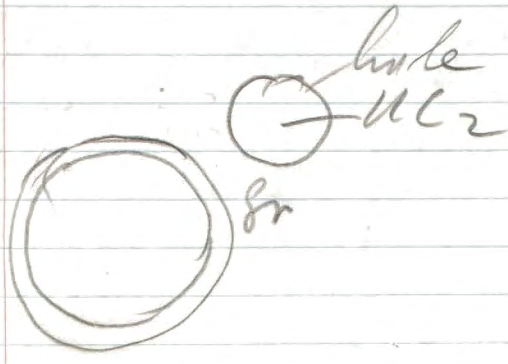
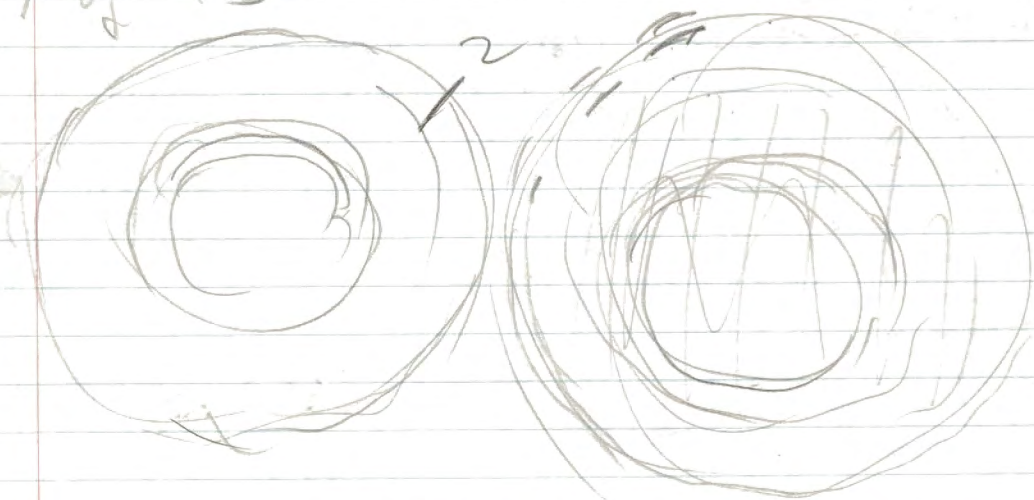
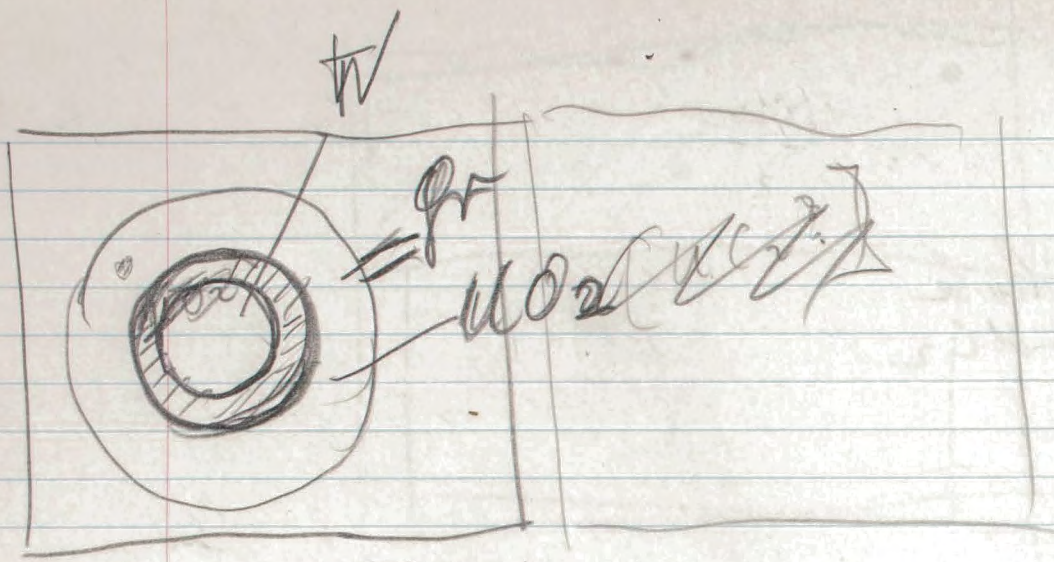
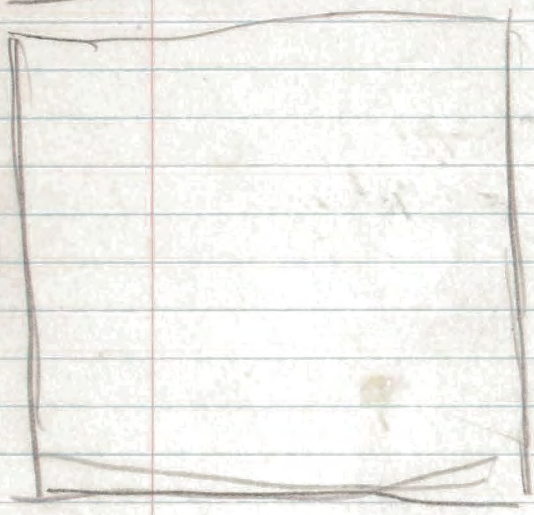
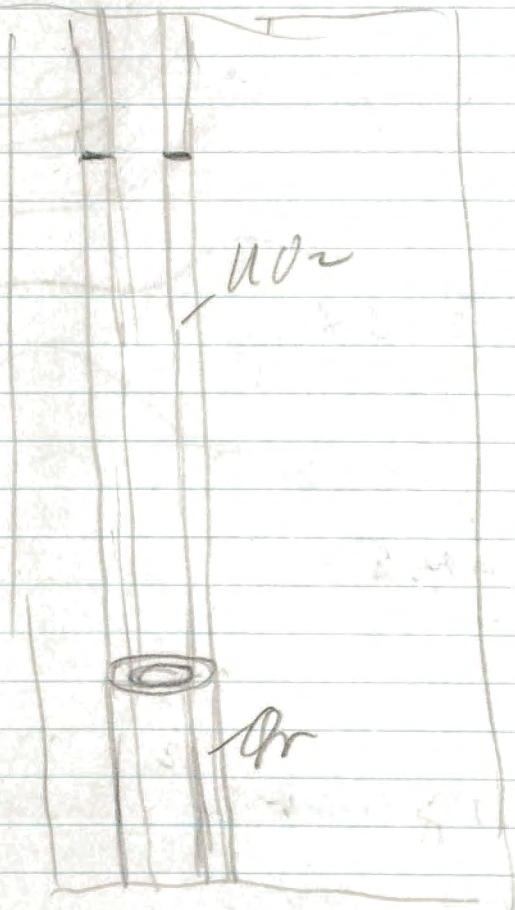


Fig 4B









for U (not Pu; Pu requires less

Size $M_c = 60\left(\frac{\rho_u}{11.3}\right)^{-2}$ kg

60 kg density 10 = 6 liter

We take 27 liter; 30 cm length for tubes

15 cm

(1 cm²)

$\frac{\text{Volt}}{10} = I \; \frac{1}{2} \; \frac{1}{6.5} \; \frac{1}{100} \; \frac{1}{20}$ Cu

$2 \times 6.5 \times 10 \times 20 = 2600$ Amps permitted

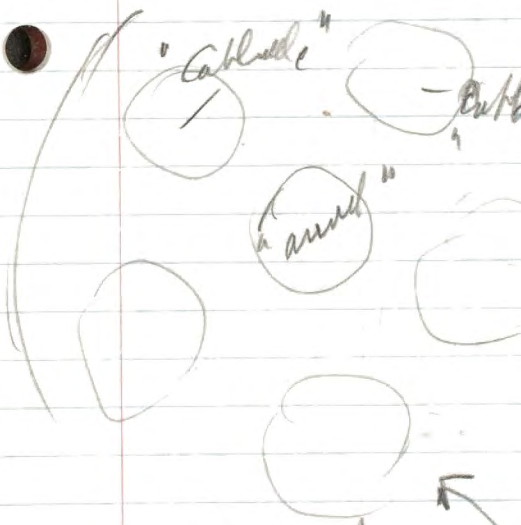
surface ~ 60 cm² $2600/60 = 44$ Amps/cm² at anode

at cathode $\frac{1}{5}$ 44 Amps/cm² =

5156

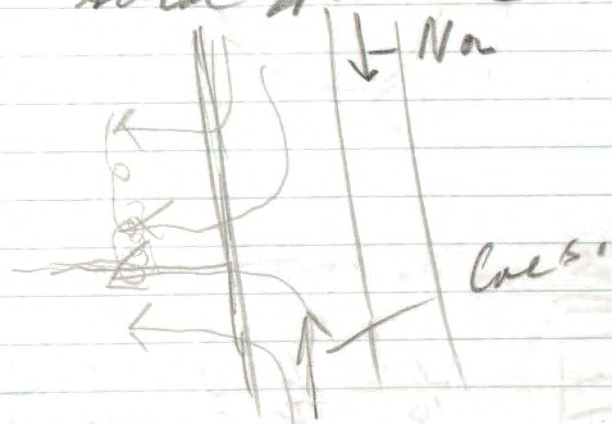
Co 5-2010 } 730 V^th Ave }
Mo 2-1513 } Hausner }

24 — 2



alternative

Maintain a density gradient along cold anode



output per tube = ~~[illegible]~~

5 KW

100 tubes 500 KW

Estimate

4 cm² 25 cm length

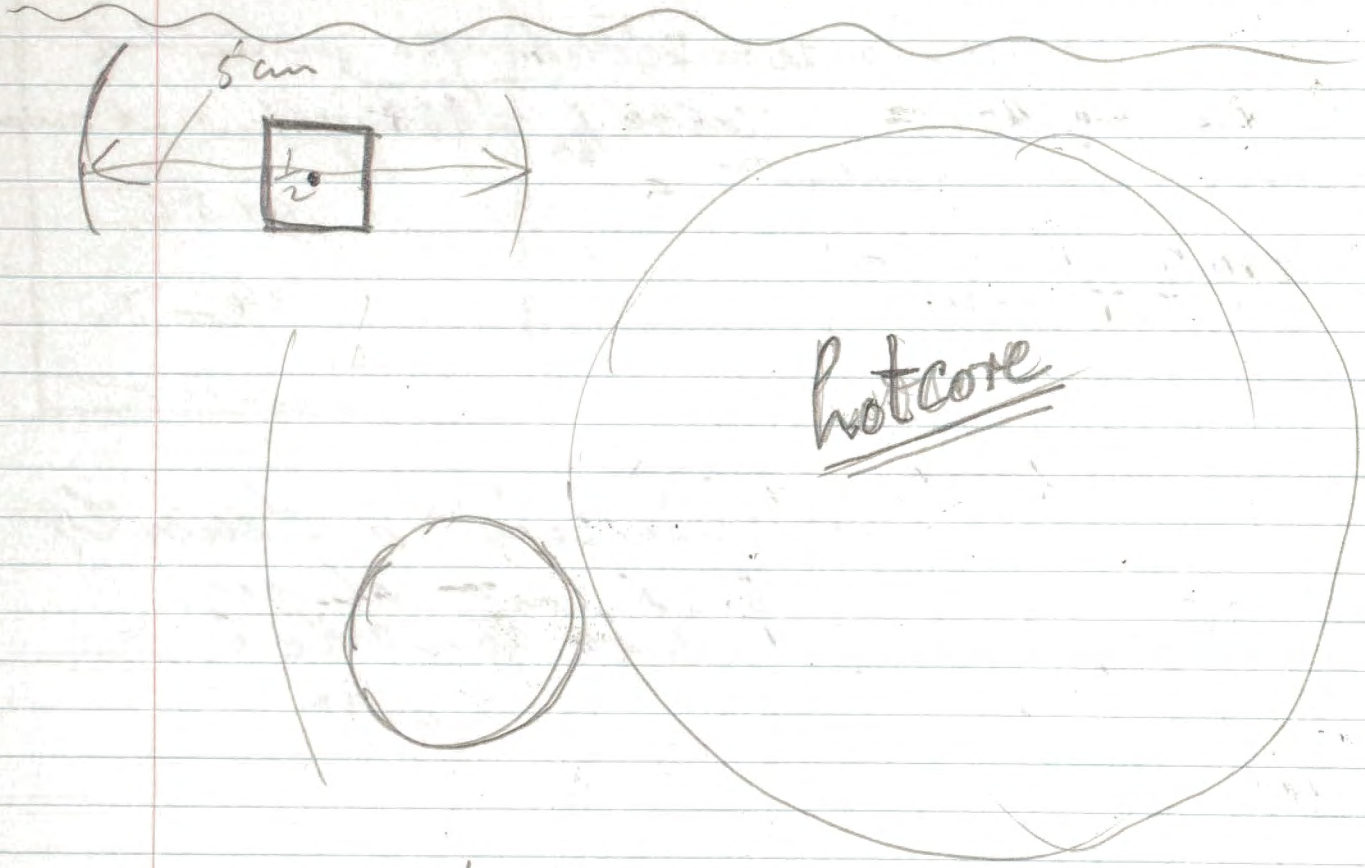
$\frac{1}{10}$ Volt loss ~~$\frac{1}{20}$~~ $\frac{1}{20}$ of Hg

current density

$\frac{1}{10} = \frac{1}{4} \frac{1}{400} \frac{1}{20} \frac{1}{y}$

$y = \frac{4 \times 400 \times 20}{10} \cong 30\,000$ Amp

or on surface $\frac{3000}{8} \cong 300$ Amps/cm²



1 cm²

25 cm $\frac{1}{10} = \frac{1}{2} \frac{1}{20} \frac{1}{4} \frac{1}{100} \frac{1}{y}$

$2 \times 20 \times 4 \times 100 = y$

~~100 100~~ $y = 1600$

or per cm² surface of anode $\frac{1600}{4 \times 25} = 16$

or per cm of Kathode ~3 Amps and 3 Watt

Tubs 2800 K has $\frac{340}{50}$ Watt = 7 Watt + 12 Watt

Mo

$$100 \; \overline{\text{Tabs}}^{2} \; e^{-\frac{4.2-0.5}{kT}}$$

$$e^{-\frac{3.7}{kT}}$$

$$4 \; 10^{+6} \; 10^{-10}$$

$$400 \times 10^{-4} \; 20$$

8000

$$1.38 \times 10^{-16} \text{ erg } 2000 = 2.76 \; 10^{-13} \text{ erg}$$

$$1 \text{ el volt} = 1.6 \times 10^{-12} \text{ erg}$$

3167,69 // 3188

$$\frac{1.6 \; 10^{-12} \text{ erg}}{X} = 2.76 \; 10^{-13}$$

$$X = \cancel{\frac{2.76 \times 10^{-13}}{1.6 \times 10^{-12}}} \quad \frac{1.6 \; 10^{-13}}{2.73 \; 10^{-13}}$$

$$X = \frac{16}{2.73} = \underline{5.85}$$

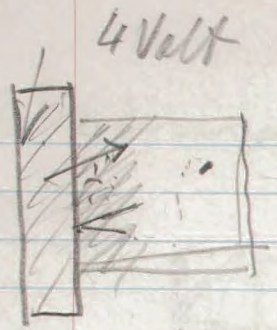
Changing $\underline{W}$!

double $\underline{\Delta V}$

N_i becomes 4 times greater

$\frac{N_i}{N}$ becomes $e^{6\Delta V}$ greater which is $\underline{\underline{20}}$

for $\Delta V = \frac{1}{2}$



1.8

$\underline{N}$ $\underline{N_i}$

$4 - \underline{\Delta V}$

$$\boxed{\frac{N_i}{N} = A e^{-\frac{(3.87 - 2\Delta V)}{kT}}}$$

$$\frac{n_i'}{n} = e^{\frac{+(4-1.8)+\Delta V}{kT}} = B$$

$\underline{n_i} + n \rightarrow$

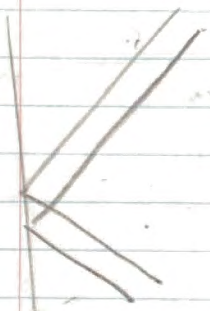
$vN_i + vN \leftarrow$

$\cancel{N_i + N}$ $\underline{n_i' + n' = v(N_i + N)}$

$\frac{N_i}{N}$ $\frac{n_i'}{n'} = B$

$\underline{n'} = vN$

$n_i = vN_i$



$\frac{n_i'}{n'} = B$ $\frac{N_i}{N} = \underline{B}$

X

Wigner says about ~~the~~ diffusion of gases through ~~that~~ hot metal sheets

in Oak Ridge : 1 Frye
Chicago : Barrett

1.) $\Delta E = \frac{1}{2}\frac{e^2}{\lambda}$; $\lambda = \sqrt{\frac{kT}{4\pi N_i e^2}}$

$$\frac{N_i}{N} = e^{+W-1.8+2\Delta E}$$

$\boxed{1.8 \geq 2\Delta E}$

1.) $\lambda = \frac{1}{2}\frac{e^2}{\Delta E} = \sqrt{\frac{kT}{4\pi N_i e^2}}$

$$\frac{1}{4}\frac{e^4}{(\Delta E)^2} = \frac{kT}{4\pi N_i e^2}$$

$$N_i = \frac{kT}{\pi e^6}(\Delta E)^2$$

$$\boxed{N = N_i e^{-(W+\Delta E)+3.87}}$$

$\Delta E = \frac{1}{2}$ Volts

$$N_i = \frac{\left[\Delta E \text{ in Volts}\right]}{\pi}$$

$\boxed{1eV = 1.6\times10^{-12} erg}$

$$N_i = \frac{\frac{1.6}{6}10^{-12}\times[\Delta E \text{ volts}]^2\times(1.6)^2\,10^{-24}}{\pi(5)^6\,10^{-60}}$$

$$= \frac{(2)^6\frac{1.6}{6}10^{-36}(1.6)^2\,(\Delta E \text{ Volts})^2}{\pi\,10^{-54}}$$

$\Delta V = 1/2$ $\quad N_i = 10^{18}\frac{4}{6}\times\frac{64}{\pi}[\Delta V]^2 = 1.36\times10^{18}(\Delta V)^2$

$N = N_i$

Transplen el. emiss.

25 cm $\frac{1}{10}$ Volt

1 cm² | 4 cm²

$\int_0^{x_0} x^2\,dx = \frac{1}{3}x^3 = \frac{1}{3}\left(\frac{1}{2}\right)^3 \frac{1}{4\times 20}$ Volt per Amp

$\frac{y}{100} \times \frac{1}{160}$ Volt/Amp² $= \frac{1}{10}$

$y = \frac{16000}{10} = \frac{1600}{\text{Amps}}$

100 cm² | permits 16 Amps/cm²

8 Amps/cm² on hot cathode; or if circular: πr^2 $2\pi r$ $\frac{2}{\pi} = 4$ $r = \frac{1}{2}$

$\frac{Q_1 - Q_2}{Q_1} = \frac{T_1 - T_2}{T_1}$ | $\frac{2400 - 800}{2400} = \frac{2}{3}$ 66%

1600 Amps | Volt
1600 watt
or 400 cal/sec.

10 10^3 cc Na | Total: 800 cal Sec.

Silver copper { take $\frac{5}{1.7}$ $\frac{60}{3}$ $\boxed{\text{20 times Hg}}$

Tungsten emission

$\cancel{e^{-A}}$ 2700K || $\varepsilon_T = \underline{0.32}$ }

1.63 Amps/cm²

factor 4 for 100°C at K = 2000 el emission

11600 °C = 1 eVolt

K = 2000 $\frac{1}{6}$ Volt

$$\frac{e^{+\frac{W_0 + \cancel{\ldots}}{\frac{1}{6}(1+0.05)}}}{e^{+\frac{W_0}{\frac{1}{6}}}} = e$$

$$\frac{e^{-\frac{W}{kT}}}{e^{-\frac{W}{kT(1.05)}}} = \cancel{e^{-\frac{W}{kT^2}\Delta T}} \quad e^{\frac{W}{kT}\frac{\Delta t}{T}}$$

$$1.4 = \frac{W}{kT}\frac{5}{100} \qquad kT = \frac{1}{6}$$

$$1.4 = \frac{30}{100} W$$

$$\frac{140}{30} = W = \underline{4.67}$$

Tungsten

Radiation

~~1 erg = 1.6 10⁻¹² eV~~ $K_{const} = 5.7\ 10^{-5}$ erg/cm²

Rad. loss (black) $= 5.7 10^{-12}$ Joule $\left(\frac{T_{abs}}{1000}\right)^4 10^{12}$

$= 5.7 \times \left(\frac{T_{abs}}{1000}\right)^4$ watts

$T_{abs} = 2000 = 5.7 \times 16$ watts = 90 watts

$T_{abs} = 2500 = 5.7 \times 39$ = 233 watts

$T_{abs} = 3000 =$ = 460 watts

↳ for W this means 14.2 Amp/cm²

T = 3000 $5.7 \times 81 \cong 450$ Watts

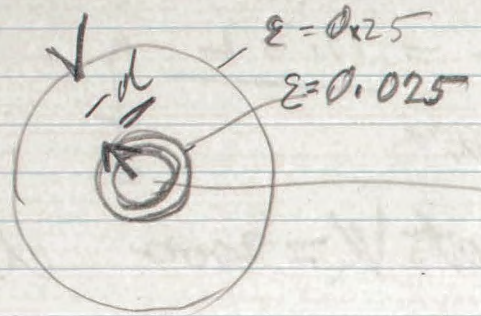
Tungst. Amps

2800 = T_{abs}

3.54 Amp/cm²

$5.7 \times 6 = 340$ Watt

Radiation Gradient needed:

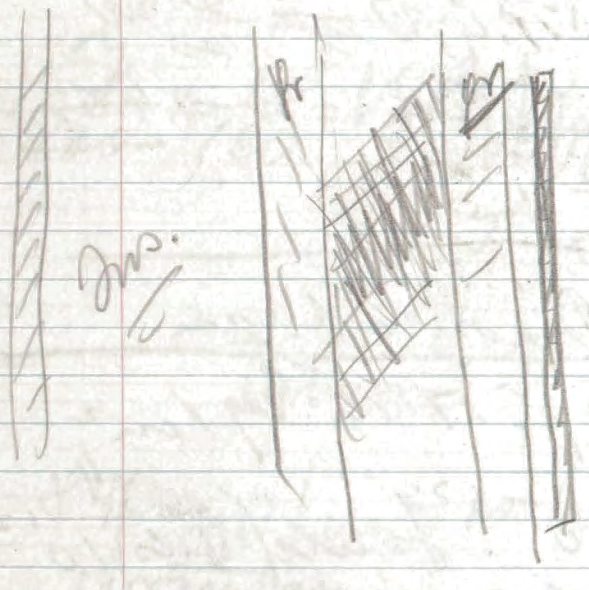


maximal Temp diff
lower temp must not condense, upper Temp must be low enough to have still ~~[illegible]~~ Coe work function.

$\frac{1}{10}$ of black and factor 3 × $\frac{1}{30}$ this determines diameter of ~~[illegible]~~ "anode".

$$A \Delta T T^3 = \frac{1}{30} A T^4$$

$$\Delta T = \frac{T}{30} \qquad \frac{2000}{30} = 60^\circ C$$



Water

50 cm length
1 cm diam.
3×30×50 watt = 5000 Watt
~~1500 watt~~ 1200 cal
~~400 cal~~
10 meter H2O
.75×10³
750 cc
3 14 cm²

~~25 cm~~ 75 1 meter | 25×3×30 Amp + 2500 Amp

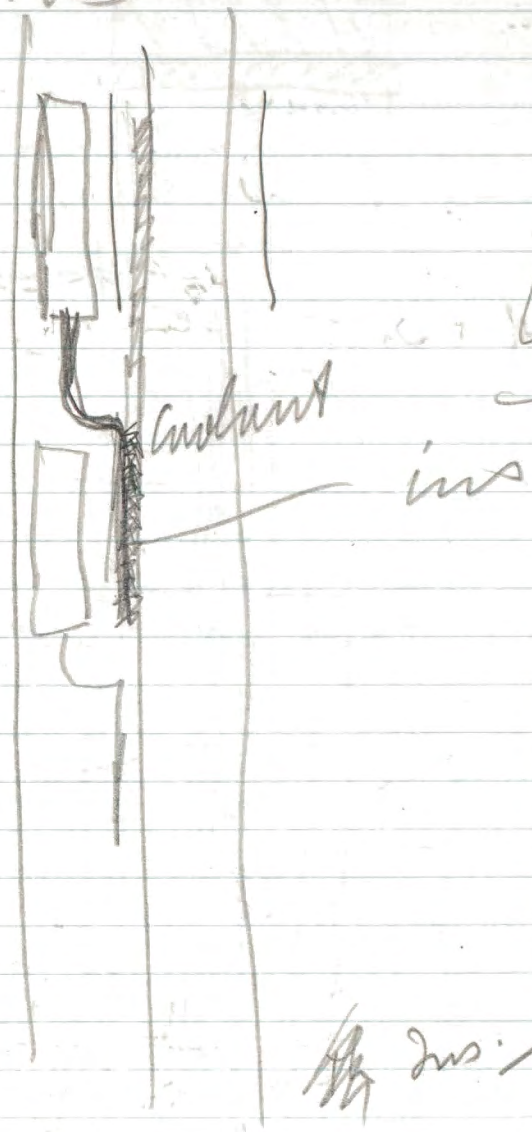
~~[illegible]~~ $\frac{6 \text{ cal}}{3} = \frac{1}{4}$

$\frac{1}{2}$ cm²

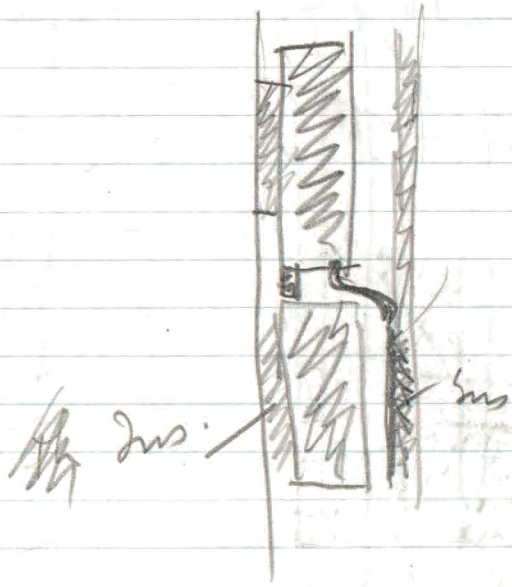
$\frac{1}{6}\Omega$

$\frac{1}{6 \times 50}\Omega = \frac{1}{300}$ 2500 + 2500 watt 3 hrs

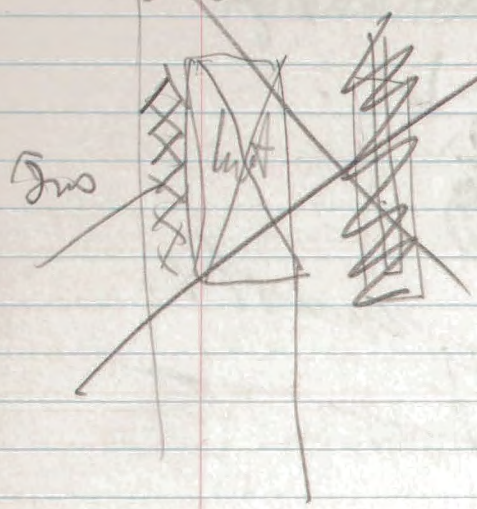
Radiation cooling in series



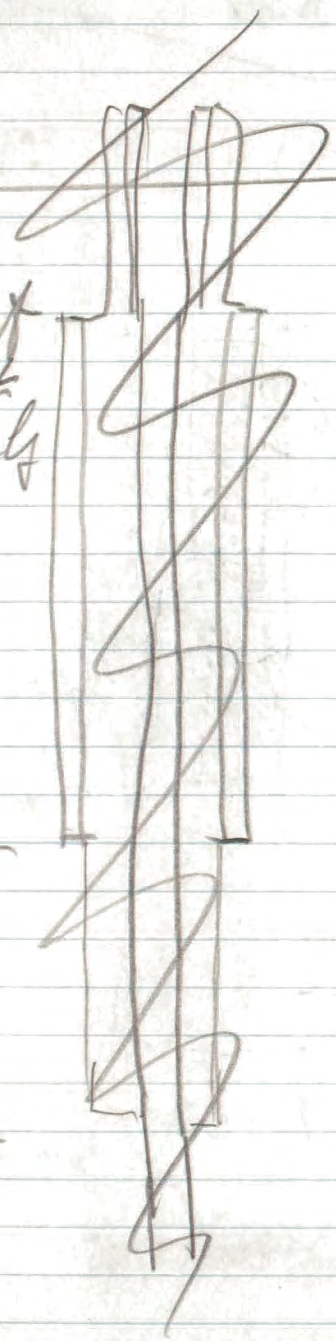
Lousy constr.

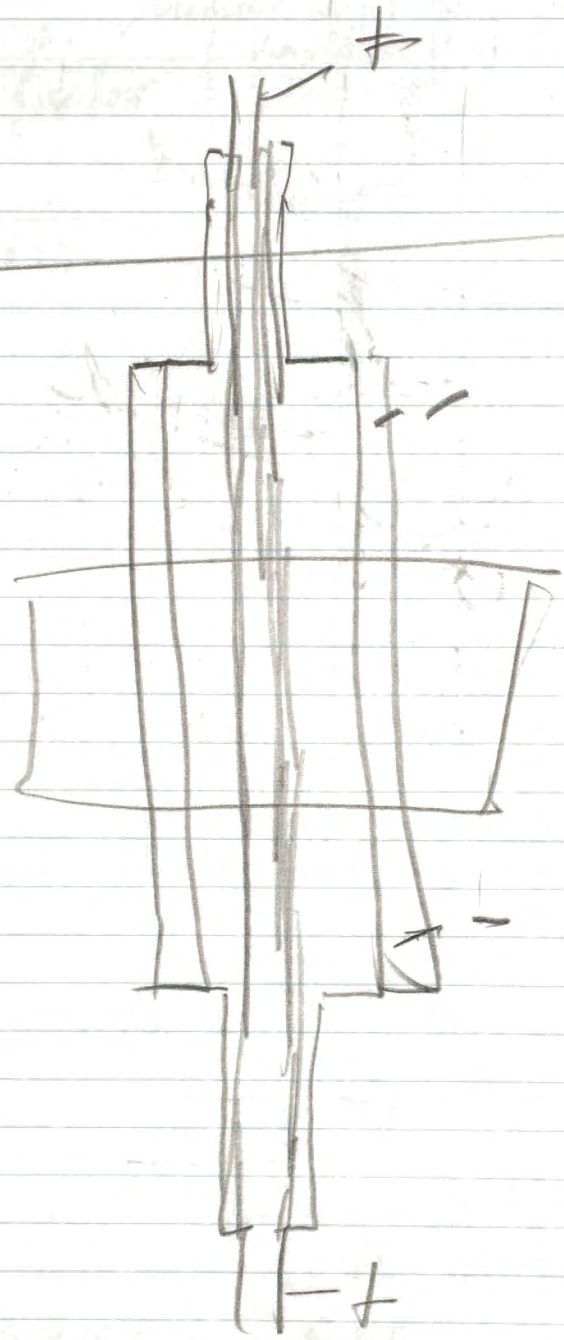


In series ?

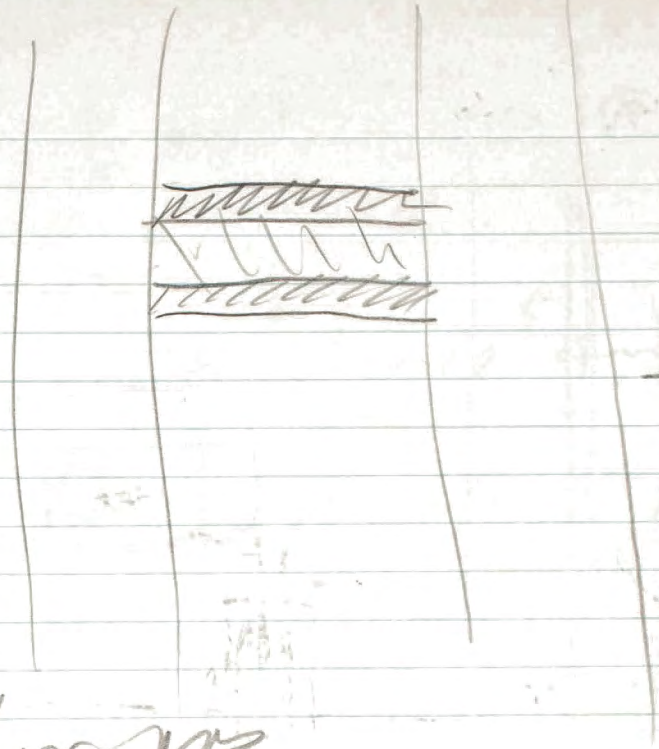


For Gas
with preheat
conic & ~~both~~
other air nately

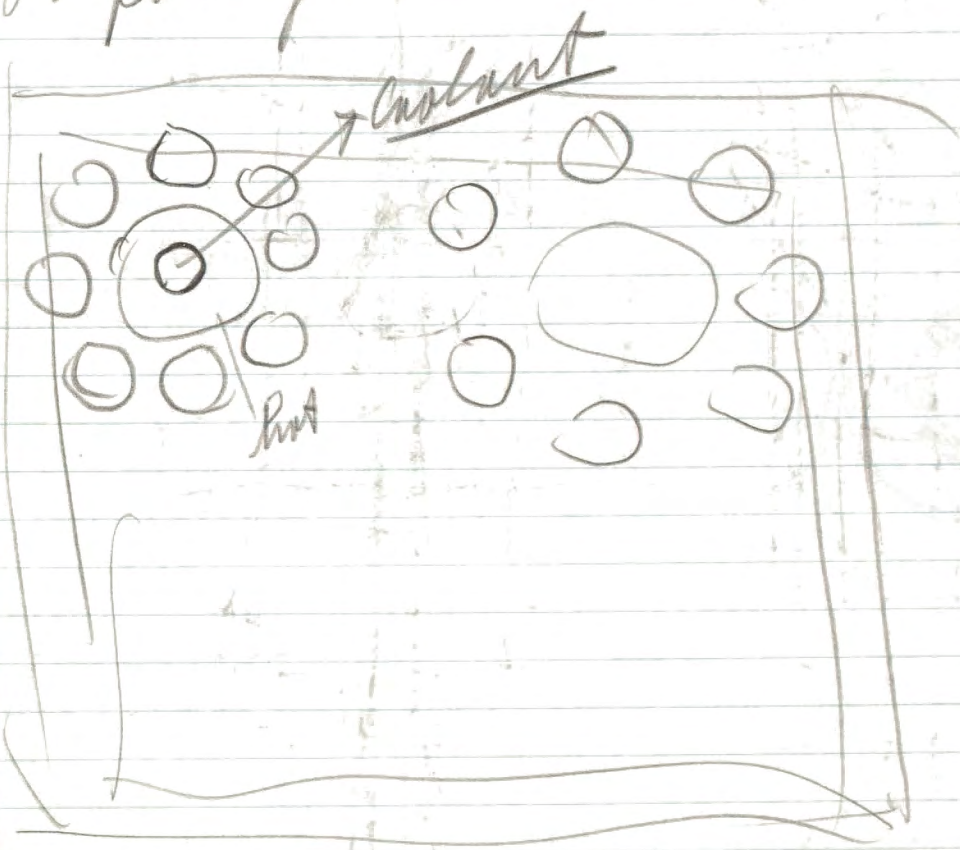


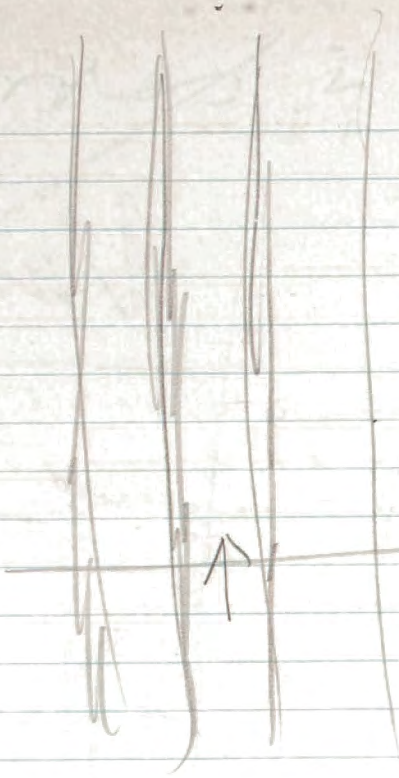


Nuclear



Os for gas

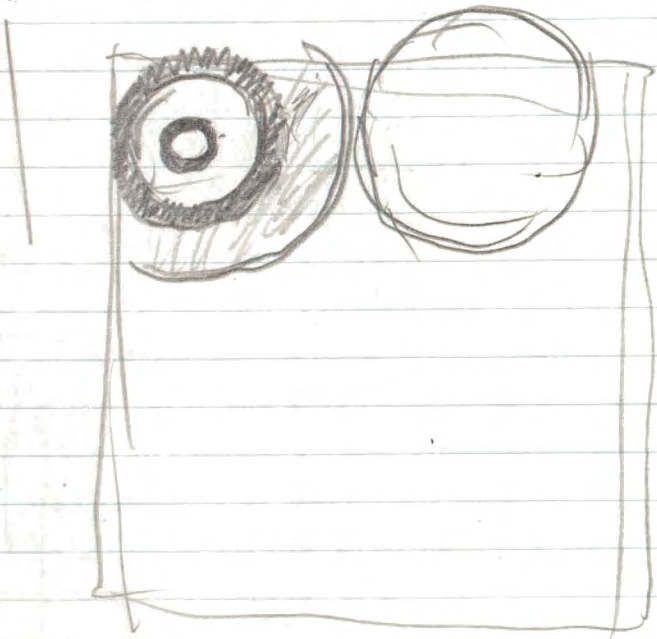




or

6 cm 50 cm 30 watt/cm²

300 cm² 300×30 = 10 kW



Hatam

$v = \sqrt{\frac{1}{20}\, 10^{12}} \approx 2\ 10^{5}$ H

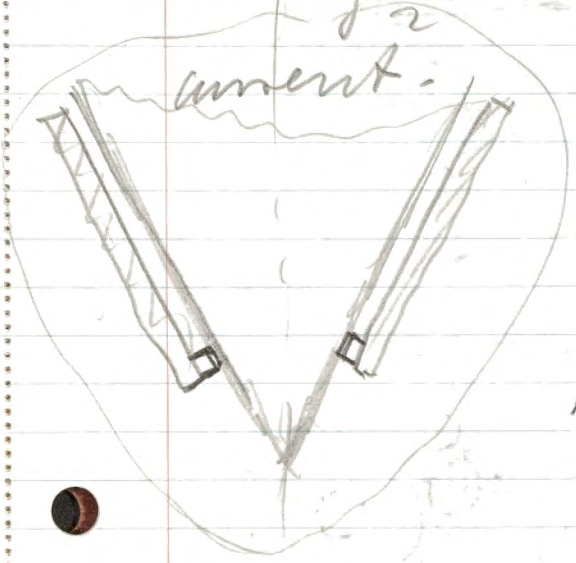
at 2000K

$vel = \sqrt{1800}\ 2 \times 10^{5}$ cm

$40 \times 2 \times 10^{5}$ cm

Lubricating $\frac{1}{2}$ and $\frac{1}{2}$ Volt to buck.

current.



$\frac{Ni\ 4 \times 10^{6}\ 5\ 10^{-10}}{3\ 10^{9}}\ e^{-3}$ Amps/cm²

for 1 Amp

$Ni = \frac{\cancel{40} \times 3\ 10^{9}\ 10^{13}}{\cancel{40} \times 10^{6}} = 3\ 10^{16}$

O.K.

Solve eqn.
Energy loss in gas

for $\frac{1}{2}$ eV we have therefore for N_i

$$\frac{2.7 \times 3.75 \times 10^{-14}}{300} \frac{\frac{3}{5} 10^{+12}}{\cancel{\sqrt{\frac{1}{4}}}} \frac{\sqrt{N_i}}{\sqrt{RT}}$$

$$= \frac{1}{5} 10^{-15} 10^{+12} \sqrt{N_i} \frac{1}{\sqrt{\frac{3}{5} 10^{12}}}$$

$$= \frac{1}{5} 10^{-3} \sqrt{N_i} \frac{1}{\sqrt{10^{11}}}$$

$$\sqrt{N_i}$$

$$5 10^{3} \sqrt{10^{11}} = \sqrt{N_i}$$

$$\sqrt{2.5 \, 10^{18}} = \sqrt{N_i}$$

$\sqrt{150}$ $1 \mathring{A}$

$3 10^{17} = N_i$ $\quad \sqrt{\frac{\frac{1}{2} kTN}{mN}} = v$

for H atom $v = \sqrt{\frac{1}{2} RT} \cong \sqrt{\frac{1}{12} eV}$

$$\Delta E = \frac{1}{2}\frac{e^2}{\lambda_D}$$

$$\lambda_D = \sqrt{\frac{kT}{4\pi N_i e^2}}$$

$$\lambda_D = \sqrt{\frac{RT}{4\pi N_i e^2 \, 6\,10^{23}}}$$

H

$\frac{1}{2}$ el volt ~

~ 10^{-12} erg

$\lambda_D = \frac{1}{2}\,\frac{25\,10^{-20}\,10^{12}}{}$

$\lambda_D = 10^{-7}$ cm

$$\Delta E = \frac{1}{2}\,\frac{e^3\sqrt{4\pi\, 6\,10^{23}}\,\sqrt{N_i}}{\sqrt{RT}}$$

$$\Delta E = \frac{1}{2}\,\frac{5^3\,10^{-30}\,\sqrt{2\cdot 4\pi}\,10^{12}\,\sqrt{N_i}}{\sqrt{RT}}$$

$\boxed{\text{to get } \frac{1}{2}\text{ Volt}}$ → compute N_i

$$1 \quad \frac{1}{2} = \frac{1}{2}\,300 \times 125 \times 10^{-18} \times 2.7 \times \sqrt{N_i}$$

$$= \frac{3.75\times 10^4 \times 2.7\,\sqrt{N_i}\;10^{-18}}{\sqrt{\frac{300}{6}}}$$

$1 =$

$5\,10^{-10}\,\frac{1}{300}$ erg $= 1$ EV

or

ΔE in el volt $=$

$\frac{3}{5}\,10^{12}\,[\qquad\qquad]$

4 Amp/cm² on Kathode

$$\frac{n^2}{n_a} = 1.7\times10^{20}\, e^{-\frac{W_i}{kT}}$$

for K = 2000

neutral Atoms

$$1.7\times10^{20} = \frac{(2\pi k T m)^{3/2}}{h^3}\, e^{-\frac{W_i}{kT}}$$

UC

Pidd

Tantalum. 2 cm² T = 2025

Ce 10^{-4} m/m 0.2 Amp/cm²

UC ~~124 Amps 15%~~

(H)

Temp

15% 2000°

85% ZnC_1

2700°

Temp? ZnC ~~[illegible]~~ 60/cm²

30 Watts /per cm² useful

1 Volt 30 Amps

Temp? Tantalum (Cos.)

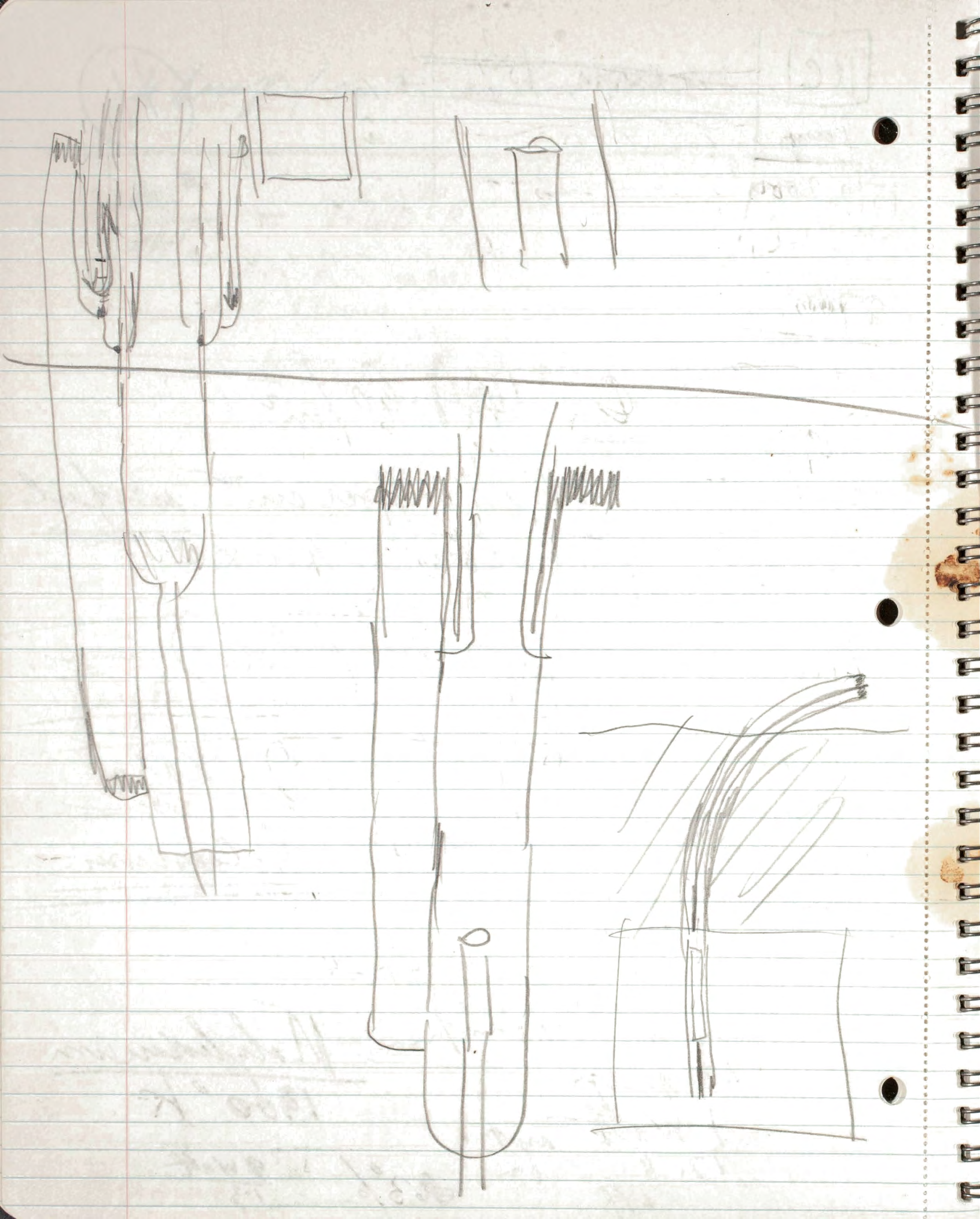
G.N. HATSOPOULOS & J. Kaye
proc. of IRE Sept.
p. 1574 Sept. ~~78~~ 58

No Coesium

Volney Wilson
Memo Report No EP-4
Mar 1958
Coesium 1.5 mm/m
1.3 Amps
1 Watt out
12. " in
eff 8.3%

Molybdenum
1900° K

9 Watt
1.3



$5.7\ 10^{-8}\ 10^{-4}\ T^4$ watts / cm²

100 Amps 1 Volt . gain

loss for $T = 2000\,°C$ 16×10^{12}

5.7×16 100 watts / cm²

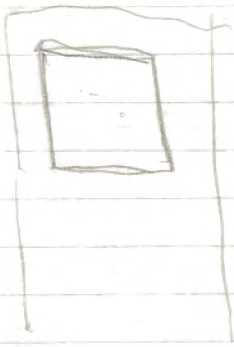
$60\ \cancel{T^2}\ 4 \times 10^6$

$= 2.4 \times 10^8$ Amps

e^-

$RT =$ 600 300

$A = 1 \quad 4 \times 10^6 \times e^{-\frac{23}{16}} = 4\,10^6 e^-$



$\int_{1/2}^{1} T^4 dt$

$\frac{1}{2} - \frac{dT}{dt} = T^4$

$\int_{1/2}^{1} dT \frac{1}{T^4} = dt$

T^{-3}

$-\frac{1}{3} T^{-4}$

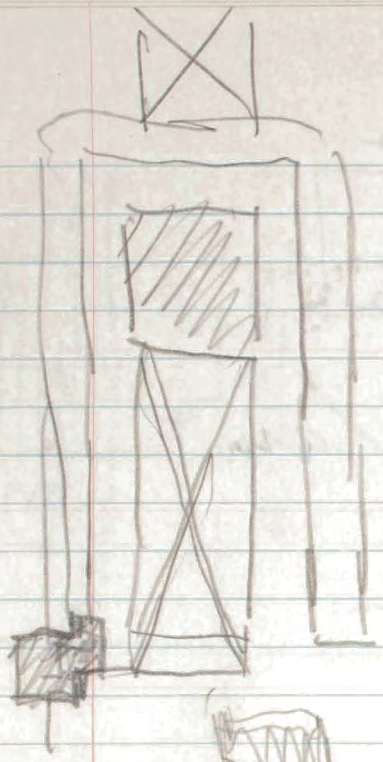
$\left[\frac{1}{3} \frac{1}{T^3}\right]_{1/2}^{1}$

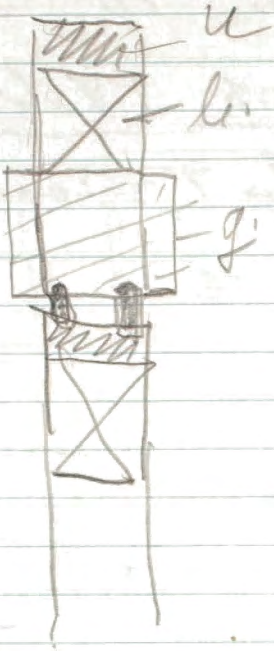
4 Volt R

24

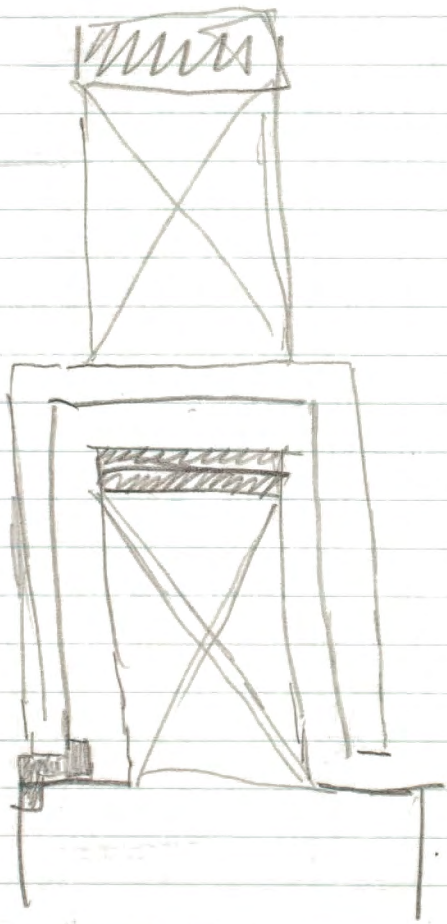
RT ln of temp amps for $\frac{3}{4}$ | $\frac{27}{16}$

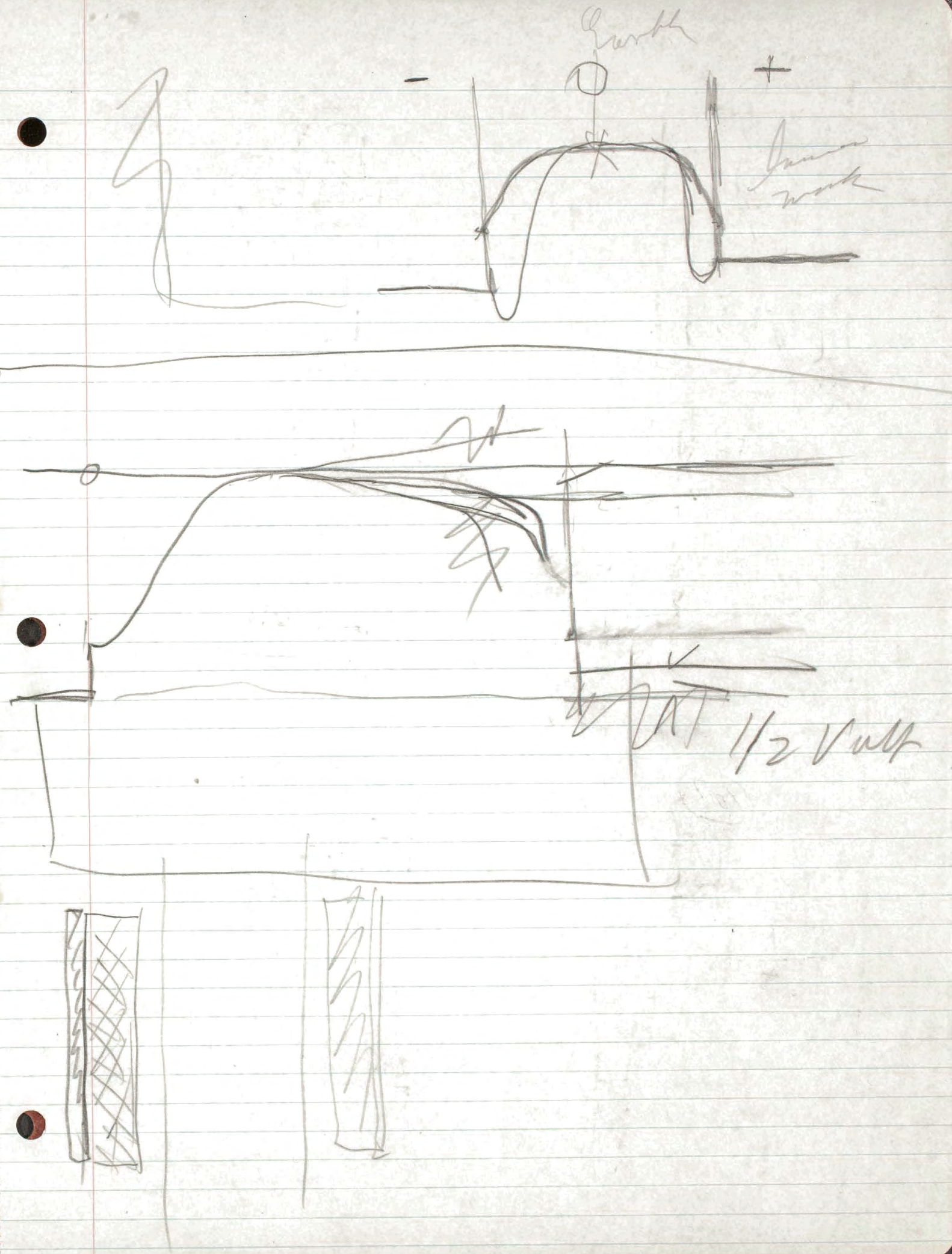
$\boxed{\text{Show } 9}$





or





Earth
-
+
1/2 Volt

1000 mil ? meter

$6\,10^{23}$ / liter = $6\,10^{20}$ / cc

$6\,10^{+17}$ ×

$6\,10^{17} \times 10^{4}\ 5\ 10^{-10}$ el stat / sec cm²

$\frac{1}{300} \times 1$ Coul $= 10^{7}$ erg

1 Coul = $3\,10^{9}$ el stat

Amps = $6\,10^{17} \times 10^{4} \times \frac{5}{3}\,10^{-19} = 10^{3}$ Amps

$RT \ln \frac{}{6\,10^{20}}$

$\frac{3.6}{e^{\frac{1}{6}}}$

$\frac{1}{6} \ln 10^{3} = 6$

$600\ 10^{18}$

$\sqrt[3]{600} \times 10^{6}$

10^{7}

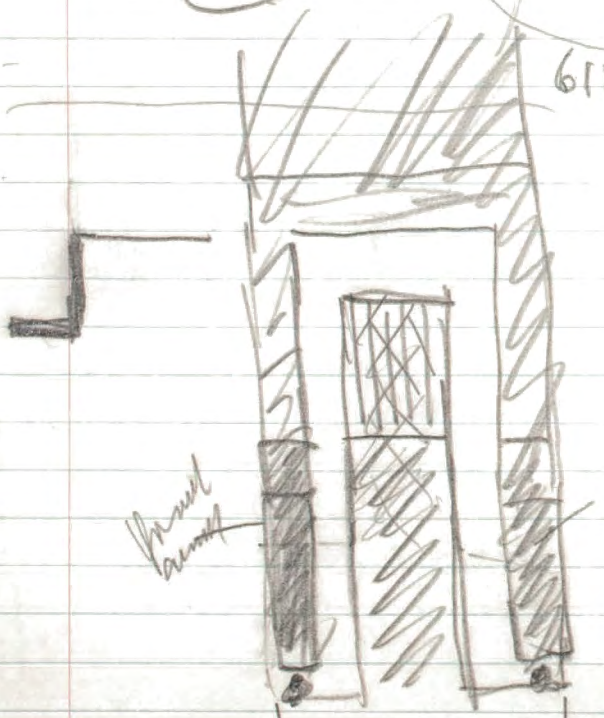
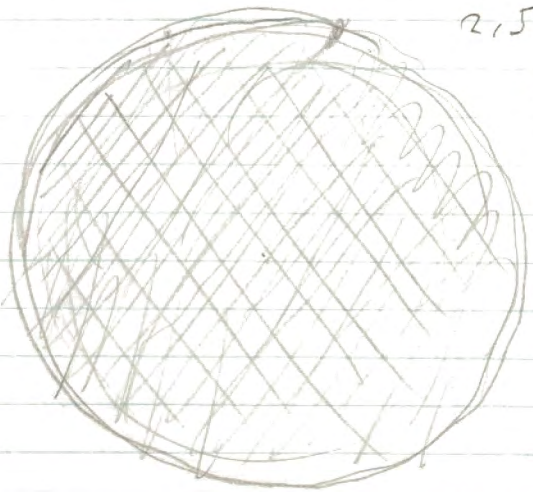
$RT \ln \frac{10^{24}}{\cancel{4}\,10^{17}}$

$6\,10^{17}$ At/cc

$\frac{1}{6}\ 2.3 \times 7 \times \ln \frac{1}{\varphi}$

$10^{7}\ \frac{25\,10^{-20}}{\cancel{10^{7}}}$

$2.5\ 10^{8} \times 10^{-20}$

2.3

$e^{-\frac{3.7}{16}}$