11/12/40

\[ e^{-264x} \]

\[ A e^{-1068x} - 2.503 e^{-264x} \]

\[ B \sinh 3.707x + C \sin 3.352x \]

\[-1.302 B \sinh 3.707x + 0.5444 C \sin 3.352x \]

Connect at \( R \) (continuous function + first derivative)

<table>
<thead>
<tr>
<th>( R )</th>
<th>( e^{-264R} )</th>
<th>( \sinh 3.707R )</th>
<th>( \cos \ldots )</th>
<th>( \sin 3.352R )</th>
<th>( \cot )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.2574</td>
<td>3.113</td>
<td>3.269</td>
<td>0.9946</td>
<td>-0.1039</td>
</tr>
<tr>
<td>6</td>
<td>0.2054</td>
<td>4.569</td>
<td>4.677</td>
<td>0.9051</td>
<td>-0.4252</td>
</tr>
<tr>
<td>7</td>
<td>0.1578</td>
<td>6.660</td>
<td>6.735</td>
<td>0.7151</td>
<td>-0.6990</td>
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<tr>
<td>8</td>
<td>0.1212</td>
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<td>9.729</td>
<td>0.4454</td>
<td>-0.8953</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>( R )</th>
<th>( e^{-1068R} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.5863</td>
</tr>
<tr>
<td>6</td>
<td>0.5270</td>
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<tr>
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<td>0.4736</td>
</tr>
<tr>
<td>8</td>
<td>0.4257</td>
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\( 204060 \)
\[ R = 5 \]

\[ 0.113B + 1.9946C = 0.2674 \]
\[ 1.212B - 0.0348C = -0.0706 \]
\[ 3.130B + C = 0.2689 \]
\[ 34.828B - C = -2.0287 \]
\[ 37.958B = -1.7598 \]

\[ B = -0.0464 \]
\[ C = 0.4140 \]
\[ A = 5.2467 \]
\[ 1.8448 \]
\[ \epsilon = 0.3787 \]
\[ 0.165 \]
\[ 0.0042 \]

\[ R = 6 \]

\[ 4.549B + 0.9051C = 1.2054 \]
\[ 1.734B - 0.1424C = -0.0542 \]

\[ B = -0.00892 \]
\[ C = 0.2719 \]
\[ A = 1.3304 \]
\[ \epsilon = -0.0618 \]

\[ R = 75.7 \]

\[ 6.660B + 0.7151C = 0.1578 \]
\[ 2.497B - 0.2342C = -0.0417 \]
\[ e^{-0.264 \times 5.1} = 0.2604 \]
\[ \sin \theta = 0.9905 \]
\[ 0.6 \]
\[ e^{-0.1068 \times 5.1} = 5764 \]
\[ \cos \theta = -0.1372 \]

\[ \sinh \theta = \left\{ \begin{array}{l} 3.2362 \\ 3.3872 \end{array} \right. \]
\[ \cosh \theta = \left\{ \begin{array}{l} 3.2362 \\ 3.3872 \end{array} \right. \]
\[ B \sinh 0.3707R + C \sin 0.335R = e^{-0.264R} \]

\[ 0.3707B \cosh 0.3707R + 0.335C \cos 0.335R = -0.264e^{-0.264R} \]

\[ \frac{B}{C} \]

\[ A e^{-0.1068R} = 2.503e^{-0.264R} - 1.302B \sinh 0.3707R + 1.5444C \sin 0.335R \]

\[ + 0.1068Ae^{-0.1068R} = 0.6608e^{-0.264R} - 0.4827B \cosh 0.3707R \]

\[ + 0.1824C \cos 0.335R \]

\[ R = 8 \]

\[ 9.678B + 0.4454C = 712.12 \]

\[ 3.6068B - 0.2919C = 0.0320 \]

\[ R = 5.1 \]

\[ 3.2362B + 0.9905C = 0.2604 \]

\[ 1.2556B - 0.0460C = -0.0687 \]

\[ R = 5.043 \]

\[ B = -0.0438 \]

\[ C = 0.4056 \]

\[ A = 1.8231 \]

\[ E = -0.0056 \]
Inside
\[
\begin{bmatrix}
0.4056 \sin 0.3357r & -0.438 \sinh 0.3357r \\
0.2208 \sin 0.3357r & +0.0570 \sinh 0.3357r
\end{bmatrix}
\]
\[R = 5.04\]

Outside
\[
\begin{bmatrix}
e^{-0.264r} \\
-2.503 e^{-0.264r} + 1.823 e^{-0.1068r}
\end{bmatrix}
\]

\[n \quad P_1 \quad P_1^n \quad P_2 \quad P_2^n\]
\[
\begin{array}{cccc}
0 & 0 & 0 & 0 \\
1 & 1.168 & 1.17 & 0.0942 & 0.094 \\
2 & 2.164 & 1.433 & 0.1823 & 0.367 \\
3 & 2.831 & 0.849 & 0.2636 & 0.791 \\
4 & 3.034 & 1.214 & 0.3340 & 1.336 \\
5 & 2.671 & 1.835 & 0.3970 & 1.985 \\
6 & 2.052 & 1.231 & 0.4470 & 2.682 \\
7 & 1.576 & 1.103 & 0.4688 & 3.282 \\
8 & 1.210 & 0.969 & 0.4730 & 3.784 \\
9 & 0.929 & 0.836 & 0.4648 & 4.183 \\
10 & 0.714 & 0.714 & 0.4480 & 4.480 \\
11 & 0.548 & 0.603 & 0.4260 & 4.686 \\
12 & 0.421 & 0.505 & 0.4008 & 4.810 \\
13 & 0.323 & 0.420 & 0.3741 & 4.863 \\
14 & 0.248 & 0.347 & 0.3467 & 4.854 \\
15 & 0.191 & 0.286 & 0.3196 & 4.794 \\
16 & 0.146 & 0.234 & 0.2937 & 4.699 \\
17 & 0.113 & 0.192 & 0.2685 & 4.564 \\
18 & 0.086 & 0.155 & 0.2453 & 4.415 \\
19 & 0.061 & 0.125 & 0.2233 & 4.243 \\
20 & 0.041 & 0.102 & 0.2027 & 4.054 \\
21 & 0.030 & 0.082 & 0.1839 & 3.862 \\
22 & 0.020 & 0.066 & 0.1665 & 3.663 \\
23 & 0.013 & 0.053 & 0.1506 & 3.464 \\
24 & 0.008 & 0.040 & 0.1361 & 3.266 \\
25 & 0.005 & 0.035 & 0.1228 & 3.070 \\
26 & 0.003 & 0.026 & 0.1100 & 2.886 \\
27 & 0.002 & 0.022 & 0.1000 & 2.700 \\
28 & 0.001 & 0.017 & 0.0902 & 2.526 \\
29 & 0.001 & 0.015 & 0.0811 & 2.352 \\
30 & 0.000 & 0.012 & 0.0731 & 2.193
\end{array}
\]
\[ \int_0^{5.04} (p_1 + p_2) r \, dr = \text{loss} = 0.9674 \]
\[ \int_0^{5.04} p_1 r \, dr = 3.32 \quad \int_0^{5.04} p_2 r \, dr = 3.59 \]
\[ \int_0^{5.04} (0.003 p_1 + 0.01 p_2) r \, dr = \text{gain} \]
\[ \int_0^{5.04} p_1 r \, dr = 8.84 \quad \int_0^{5.04} p_2 r \, dr = 12.12 \]

\[ \text{loss} = \int_0^{5.04} \frac{0.0877}{r} \sinh \frac{3.35}{r} \, dr + 0.00185 \int_0^{5.04} \sinh \frac{3.707}{r} \, dr \]

\[ \text{gain} = 0.0182 \int_0^{5.04} e^{-0.1068 r} \, dr - 0.0220 \int_0^{5.04} e^{-2.64 r} \, dr \]

\[ \int_0^{5.04} \sinh \frac{3.35}{r} \, dr = -5.04 \cos 1.668 + \frac{1}{0.335^2} \]
\[ \sin 1.668 = 0.204 \quad 0.335^2 = 0.1122 \]

\[ \int_0^{5.04} \sinh \frac{3.707}{r} \, dr = 5.04 \cosh 1.868 - \frac{1}{0.3707^2} \]
\[ \cosh 1.868 = 22.07 \quad 0.3707^2 = 0.137 \]

\[ \int_0^{5.04} e^{-0.1068 r} \, dr = \frac{5.04}{0.1068} e^{-0.5382} + \frac{1}{0.1068^2} e^{-0.5382} = 78.62 \]

\[ \int_0^{5.04} e^{-2.64 r} \, dr = \left( \frac{5.04}{2.64} + \frac{1}{2.64^2} \right) e^{-1.3306} = 8.835 \]

\[ \text{loss} = 0.9674 \quad \frac{\text{gain}}{\text{loss}} = 1.278 \]

\[ \text{gain} = 1.236 \]
Metal lattice

Fast fissions

Slow fissions

\[ \frac{\text{Fast fissions}}{\text{Slow fissions}} = \beta \]

\[ \beta = 1.05 \]

One fast neutron is produced:

1. It may be slowed down.
2. It may produce fast fission

Thus generating all together.

One thermal fission is immediately followed by:

\[ \frac{\nu (1-\alpha)}{1-\nu a} \]

Neutrons beginning slowing down.

Of these \[ \frac{\nu (1-\alpha)}{1-\nu a} \] neutrons

One neutron begins being slowed down.

\( L \), leak out before resonance

\( (1-L) (1-\nu) \) are captured at resonance

\( (1-L) P \) become thermal
One neutron becomes thermal
\[ (1 - L_2) f \varphi \] produce thermal fissions
\[ (1 - L_2)f(1 - \varphi) \] are captured at resonance
\[ (1 - L_2)(1 - f) \] are captured by moderator and coolants

Critical condition
\[ \eta = \nu \varphi \]

\[ 1 = \frac{\nu(1 - a)}{1 - \nu a} (1 - L)p(1 - L_2)f\varphi \]

\[ \kappa = \frac{\nu(1 - a)}{1 - \nu a} p f \varphi \]

Fast fission
\[ \varphi = \frac{\nu a}{1 - \nu a} \]

Slow fission
\[ \text{Fast fission} = \frac{\nu a}{1 - \nu a} \]

\[ \text{Formation of } \nu^{9} = \frac{\nu(1 - a)}{1 - \nu a} (1 - L)(1 - p) + \frac{\nu(1 - a)}{1 - \nu a} (1 - L)p (1 - L_2)f\varphi \]

\[ \text{Loss of } \nu^{9} \text{ or } 5 = \frac{\nu(1 - a)}{1 - \nu a} (1 - L)p (1 - L_2)f\varphi \]

\[ = \frac{1 - \varphi}{\varphi} + \frac{1 - p}{1 - L_2} \]

\[ = \frac{1 - \varphi}{\varphi} + \frac{1 - p}{1 - L_2} \frac{1 - \varphi}{\varphi} \]

\[ = \frac{1 - \varphi}{\varphi} + \frac{1 - p}{1 - L_2} \frac{1 - \varphi}{\varphi} \]

\[ = \frac{1 - \varphi}{\varphi} + \frac{1 - p}{1 - L_2} \left( \frac{1 - \varphi}{1 - \nu a} \right) \]

\[ = \frac{1 - \varphi}{\varphi} + \frac{1 - p}{1 - L_2} \left( \frac{1 - \varphi}{1 - \nu a} \right) \]
Numerical example

\[ v = 2 \quad \gamma = 1.3 \quad \frac{\nu}{\gamma} = \frac{1.3}{2} = 0.65 \]

\begin{align*}
\text{Fast fissions} & = 0.15 \\
\text{Slow fissions} & = 0.02 \\
\frac{\nu a}{1 - \nu a} & = 0.15 \\
\nu a & = 0.1304 \\
a & = 0.0652
\end{align*}

From exit condition

\[ 1 = \frac{2 - 0.1304}{1 - 0.1304} \times 0.98^2 \times 0.65 \times pf \]

\[ pf = 0.7451 \]

\[ \frac{\text{Formation}}{\text{Loss}} = 0.5385 + \frac{2 - 0.1304}{1 - 0.1304} \times 0.98 \times 1.628 = 0.8815 \]

\[ 2.1500 \]

\[ \text{Same conditions with } v = 2.2 \]

\[ \frac{\nu}{\gamma} = \frac{1.3}{2.2} = 0.591 \quad \nu a = 0.1304 \]

\[ \frac{\text{Formation}}{\text{Loss}} = \frac{2.2 - 1.3}{1.3} + \frac{2.2 - 0.1304}{1 - 0.1304} \times 0.98 \times (1 - p) = 0.692 + 2.332 (1 - p) \]

\[ = 1.07 \]
\[ f = \frac{p}{1+p} \]

\[ p = \frac{1}{1+\alpha p} \quad \alpha = 0.15 \]

Best pf = 0.794

\[ 0.7451 = \frac{p}{(1+\alpha p)(1+p)} \]

P-9 pile may have a chance especially if cooled by P9

With notations of CP-644 (lattice cell)

\[ \alpha = \frac{p \frac{\Delta f}{\Delta \sigma}}{1-p \frac{\Delta \sigma_{\text{elastic}}}{\Delta \sigma_{\text{total}}}} \]

Example: Metal rods, \( \xi = 4 \text{ cm} \)

\[ \rho = 0.054 \]
\[ \frac{\Delta f}{\sigma} = 0.35 \]
\[ \frac{\Delta \sigma}{\sigma} = 4.5 \]

\[ \nu = 2 \]

Formation Loss

\[ \frac{\rho}{\sigma} \text{ volume ratio } \approx \frac{f}{1-f} \]

\[ \frac{120 + 4900 (1-0.97)}{(1-f)
\[ (1-L)(1-f) = 0.975 \times 0.970 \]

For \( P9 \) volume ratio \( \approx 7 \)

\[ p = 0.8 \]
\[ f = 0.97 \]

\[ E = 1.048 \]
\[ k = 1.0572 \]
\[ \frac{M^2}{k-1} = 46.67 \]
<table>
<thead>
<tr>
<th>MeV</th>
<th>1/60° E</th>
<th>310° 5° 99</th>
</tr>
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<td>157</td>
<td>196</td>
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<tr>
<td>1.0</td>
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<td>186</td>
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<tr>
<td>1.2</td>
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<td>1.6</td>
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</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\log_{10} 1.44 = 3.3
\]

\[
-33 + 13
\]

| 1   | 1580  |
| 1.2 | 1665  |
| 1.4 | 1748  |
| 1.6 | 1827  |
| 1.8 | 1917  |
|     | 1858  |
|     | 1.63  |
\[ \Pi(E) \, dE = e^{-2E} (e^{4\sqrt{E}} - e^{-4\sqrt{E}}) \, dE \]

\[ \bar{E}^2 = \frac{\int \Pi(E) \, dE}{\int \Pi(E) \, dE} = \frac{33995}{18.45} = 1843 \]

<table>
<thead>
<tr>
<th>MeV</th>
<th>( \Pi(E) )</th>
<th>MeV</th>
<th>( \Pi(E) )</th>
</tr>
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<td>8</td>
<td>6.7</td>
<td>0.8</td>
<td>7.24</td>
</tr>
</tbody>
</table>

\( E^2 \approx 1843 \)
\[
\begin{align*}
T & \quad \frac{dT}{dt} \quad T/\tau \quad \theta \\
54 & \quad 1.10 \quad .85 \quad .07 \quad .92 \\
55 & \quad 1.91 \quad .80 \quad .13 \quad .93 \\
56 & \quad 2.71 \quad .76 \quad .18 \quad .94 \\
57 & \quad 3.44 \quad .70 \quad .23 \quad .93 \\
58 & \quad 4.10 \quad .64 \quad .27 \quad .91 \\
59 & \quad 4.72 \quad .60 \quad .31 \quad .91 \\
60 & \quad 5.30 \quad .57 \quad .35 \quad .92 \\
61 & \quad 5.86 \quad .54 \quad .39 \quad .93 \\
62 & \quad 6.38 \quad .50 \quad .42 \quad .92 \\
63 & \quad 6.87 \quad .47 \quad .46 \quad .92 \\
64 & \quad 7.32 \quad .44 \quad .48 \quad .92 \\
65 & \quad 7.74 \quad .42 \quad .51 \quad .93 \\
66 & \quad 8.16 \quad .39 \quad .54 \quad .93 \\
\end{align*}
\]

\[
1.3 = \frac{F}{F+C} \quad 2 \\
\frac{2}{1.3} = \frac{c}{F} \quad .538 \\
\]

\[
.925 \quad 60 = 1.87 \\
\frac{925}{29.7} \\
\]

\[
\frac{F}{C} = 93.1 \quad 1.86 \\
5.94 \\
\]

\[
\begin{align*}
\theta - \frac{1}{\tau} T &= \frac{dT}{dt} \\
13 \theta - \frac{1}{\tau} 65.61 &= 7.68 \\
65.61 \theta - 393.53 \frac{1}{\tau} &= 34.64 \\
\theta - 5.047 \frac{1}{\tau} &= .5908 \\
\theta - 5.998 \frac{1}{\tau} &= .5280 \\
.951 \frac{1}{\tau} &= .0628 \\
\sum \tau = 15.1 \\
\sum \theta = .925
\end{align*}
\]
\[ y' = 1.3 \]
\[ \frac{\sigma_i - 1.5}{.65} = 1.6 \]
\[ \sigma_i = 1.2 \]

\[ \frac{1.04}{1.5} \]
\[ = 1.2 \]

\[ \frac{1}{140} \left( \frac{0.5}{\sigma_c} \right) \frac{1.77}{1.04} = .12 \]

\[ \left( \frac{0.5}{\sigma_c} \right) = 10 \]

\[ \varphi = \frac{1}{60} \]

<table>
<thead>
<tr>
<th>66</th>
<th>8.16</th>
</tr>
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<tbody>
<tr>
<td>67</td>
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<td>3.87</td>
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<tr>
<td>80</td>
<td>3.67</td>
</tr>
</tbody>
</table>
Reduce to very short irradiation

\[ Ae^{-1.38t} + Be^{-0.154t} + Ce^{-0.030t} + De^{-0.014t} \]

\[ \int_0^\infty e^{-\lambda t} \, dt = \frac{1}{\lambda} (1 - e^{-\lambda t}) \]

\[ \int_0^\infty e^{-\lambda t} \, t \, dt = \frac{1}{\lambda^2} \]

\[
\begin{array}{cccccc}
\lambda & \frac{1}{\lambda^2} & 1 - e^{-\lambda t} & \frac{A}{\lambda^2} & 1 - e^{-\lambda t} & \frac{A}{\lambda^2} \\
1.38 & 0.725 & 0.543 & 1.050 & 0.761 & 1.2 \\
0.154 & 6.94 & 0.927 & 0.431 & 2.97 & 1.2 \\
0.030 & 33.3 & 0.985 & 0.024 & 0.818 & 1.04 \\
0.012 & 82.4 & 0.993 & 0.020 & 0.143 & 1.35 \\
0.014 & 63.7 & & & & 1.35 \\
\end{array}
\]

\[ \frac{1}{39.1} = 0.02558 \quad 1.867 \]
\[ \left[ v_9 + (v_8 - 1) \phi \right] (1 - \varepsilon) - 1 = \phi \]

\[ (2 + \phi) (1 - \varepsilon) - 1 \]

\[ 1 + \phi - 2 \varepsilon - \varepsilon \phi > 1 \]

\[ \phi - 2 \varepsilon + \varepsilon \phi \]

\[ \phi > (2 + \phi) \varepsilon \]

\[ \left[ v + (v - 1) \phi \right] (1 - \varepsilon) - 1 = \phi \]

\[ (2 + \phi) \varepsilon \phi - 1 = 0.64 + 0.82 \phi \]

\[ 0.72 \]

\[ \varepsilon \]

\[ \gamma (1 + \varepsilon) (1 - \varepsilon) - 1 \]

\[ 2 \times 1.04 = \frac{9}{k} \]

\[ 2 \times 1.04 \overline{K} \]

\[ 2.08 \times 1.04 \overline{g} \]

\[ 0.9 \]

\[ 2.08 \times 1.04 \overline{g} \]

\[ \frac{0.85}{1.03} - 1 = 0.79 \]
\[\frac{4\pi \lambda}{n} = \frac{RD}{4\pi} \int \frac{dx}{r^3} e^{-\frac{r}{\lambda}} \]

\[\int e^{-\frac{r}{\lambda}} dr = 1 - \frac{1}{\lambda} \]

\[x^2 = r^2 - R^2 \]

\[Ddx \quad xdx = r dr \]

\[\frac{2\pi D}{4\pi R} \int_0^\infty \frac{R^2 e^{-\frac{r}{\lambda}} dr}{\sqrt{2} \sqrt{r^2 - R^2}} = \]

\[1 - \frac{R}{\lambda} \int \frac{e^{-\frac{1}{\lambda} \frac{u}{u^2 - 1}}} {u \sqrt{u^2 - 1}} du = \frac{1}{u} \int \frac{u}{u \times (u^2 - 1) \frac{1}{2}} du \]

\[\int \frac{1}{u^2 - 1} du = -\frac{1}{u} \frac{1}{\sqrt{u^2 - 1}} = \int \frac{2}{\sqrt{u^2 - 1}} du \]

\[1.0 e^{-0.029t} + 0.135 e^{-0.012t} \]

\[0.029 e^{-0.029t} + 0.00162 e^{-0.012t} \]

\[\text{for } t \to \infty \]
\[ \begin{array}{cccc}
\alpha & \frac{1}{2} & \frac{1}{\alpha} (1-e^{-\alpha}) & A_t \\
1.38 & .725 & .542 & 1.050 \\
.154 & 6.49 & .926 & .431 \\
.029 & 34.5 & .985 & .0244 \\
.012 & 83 & .994 & .00135 \\
\end{array} \]

\[ 57.05 \times 1.25 \times 10^{-3} = 0.968 \]

\[ x = 0.0016757 \]

\[ \frac{3680 \left[ 0.1250 \times 0.924 \times 3.0419 \times 4.17974 \times 1.5604 \right]}{9.6171} + \frac{9.6171}{t + 1.725} + \frac{9.6171}{t + 6.5} + \frac{9.6171}{t + 34} + \frac{9.6171}{t + 83} \]
\[ i_n = \frac{47}{T} + \frac{35}{T+7} + \frac{1139}{T+65} + \frac{1795}{T+34} + \frac{584}{T+83} \]

<table>
<thead>
<tr>
<th>T</th>
<th>124</th>
<th>584</th>
<th>11.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>( i_n )</td>
<td>1.379</td>
<td>.806</td>
<td>4.017</td>
</tr>
<tr>
<td>( A )</td>
<td>.281</td>
<td>.593</td>
<td>2.822</td>
</tr>
<tr>
<td>( B )</td>
<td>8.728</td>
<td>17.577</td>
<td>12.582</td>
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<tr>
<td>( C )</td>
<td>11.361</td>
<td>19.447</td>
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<tr>
<td>( D )</td>
<td>2.821</td>
<td>4.133</td>
<td>6.167</td>
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<tr>
<td>( E )</td>
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<td>42.56</td>
<td>114.87</td>
</tr>
</tbody>
</table>

\( N \) \( \times 10^6 \)

<table>
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<tr>
<th>( T )</th>
<th>369</th>
<th>372</th>
<th>377</th>
<th>381</th>
<th>385</th>
<th>389</th>
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</thead>
<tbody>
<tr>
<td>( i_n )</td>
<td>22.91</td>
<td>41.93</td>
<td>60.88</td>
<td>80.20</td>
<td>95.66</td>
<td>114.76</td>
</tr>
<tr>
<td>( A )</td>
<td>99.396</td>
<td>98.700</td>
<td>98.020</td>
<td>97.348</td>
<td>96.691</td>
<td>96.040</td>
</tr>
<tr>
<td>( B )</td>
<td>99.404</td>
<td>98.706</td>
<td>98.012</td>
<td>97.303</td>
<td>96.736</td>
<td>96.036</td>
</tr>
</tbody>
</table>

\( A - 2291 B = 99.396 \)
\( A - 4193 B = 98.700 \)
\( A - 6088 B = 98.020 \)
\( A - 8020 B = 97.348 \)
\( A - 9566 B = 96.691 \)
\( A - 11476 B = 96.040 \)
$6A - 41634B = 586,195$
$41634A - 347421,006B = 4,046,143,202$

$A = 6939B = 97,699.2$

$A = 8345B = 97,183.6$

$1406B = 515.6 \quad B = 0.3667$

$A = 100,244$

$\Delta \times 10^6 = 100,244 - 0.3667 \times \Delta h$

$M^2 = 635$

$\Delta h = 2.33 \times 10^{-5}$
\[
\frac{0.4 \times 1.6 \times 10^{-5}}{t} dt = 6.4 \frac{dt}{t} \times 10^{-7}
\]

\[\omega_0 = 6.4 \times 10^{-7} \text{ ergs}\]

\[
\frac{\omega_0}{t} dt
\]

\[
c \frac{dT}{dt} = -\frac{T}{\tau} + \frac{1}{\tau} (q_f + q_n)
\]

\[q_n = \int_{-\infty}^{t} q(x) D(t-x) dx\]

\[
\frac{dT}{dt} + \frac{T}{\tau} = \theta_f + \int_{-\infty}^{t} \theta_f(x) D(t-x) dx
\]

\[
\frac{dT}{dt} + \frac{T}{\tau} = \Theta D(t) = \frac{x \theta}{\tau t}
\]

\[\gamma = \frac{1}{10} \text{ fraction}\]

\[T = f(t) e^{-\frac{t}{\tau}}
\]

\[f = \int \frac{x \theta}{t} e^{\frac{t}{\tau}} dt\]
\[ f = \pi^2 \int \frac{1}{\tau} e^{\frac{\tau}{2}} \, dt \]

\[ T = \frac{1}{100} \frac{\Theta \tau}{100} \frac{t}{t} \]

\[ \frac{1}{100} \frac{\Theta \tau}{t} \]

\[ \frac{1}{100} \frac{\Theta \tau}{t} \]

\[ \frac{1}{100} \frac{\Theta \tau}{t} \]

\[ t \frac{dT}{dt} + \frac{T}{t} = \frac{A}{\Theta} \]

\[ \frac{dT}{dt} + \frac{T}{t} = \frac{A}{t} \]

\[ \frac{T}{t} - \frac{T}{t_0} = \frac{A}{t} \]

\[ \Delta \left( \frac{1}{t_0} - \frac{1}{t} \right) = \frac{AT}{t} \]

\[ \frac{T}{t} = \frac{\log \frac{T_2}{T_1}}{T_2 - T_1} \]

\[ \frac{1}{T} = \int_{t_1}^{T_2} \frac{dt}{T} \]

\[ \frac{t}{T} \left( \frac{1}{t_0} - \frac{1}{t} \right) = A \]
\( 1 \, \text{ih} = 2.33 \times 10^{-5} \)

Average gen. time = \( 2.33 \times 10^{-5} \times 3600 = 0.08388 \) sec

\[
8 \times 10^8 = \frac{125}{\tau} + \frac{0.924}{\tau+7} + \frac{3.0419}{\tau+6.5} + \frac{4.1974}{\tau+34} + \frac{1.5604}{\tau+83}
\]

<table>
<thead>
<tr>
<th>( \tau )</th>
<th>Fraction/( \times )</th>
<th>( f \times \tau / \times )</th>
<th>Fraction = ( f \时代的 ( \times )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.7 )</td>
<td>( 0.761 )</td>
<td>( 0.533 )</td>
<td>( 0.001110 \times 0.00777 )</td>
</tr>
<tr>
<td>( 6.5 )</td>
<td>( 2.797 )</td>
<td>( 18.180 )</td>
<td>( 0.004080 \times 0.026520 )</td>
</tr>
<tr>
<td>( 3.4 )</td>
<td>( 0.842 )</td>
<td>( 28.628 )</td>
<td>( 0.01228 \times 0.041752 )</td>
</tr>
<tr>
<td>( 8.3 )</td>
<td>( 0.112 )</td>
<td>( 9.296 )</td>
<td>( 0.00163 \times 0.013529 )</td>
</tr>
</tbody>
</table>

| \[ 56.637 \] |

\( 0.08388 = \frac{0.0125 + f \times 56.637}{\tau} \)

\( \times = 0.0014589 \)

\( \frac{1}{\text{ih}} = \frac{54}{\tau} + \frac{3.3}{\tau+7} + \frac{113.9}{\tau+6.5} + \frac{179.3}{\tau+34} + \frac{5.81}{\tau+83} \)
<table>
<thead>
<tr>
<th>( t )</th>
<th>( \frac{54}{t} )</th>
<th>( \frac{33}{t+7} )</th>
<th>( \frac{1139}{t+6.5} )</th>
<th>( \frac{1793}{t+34} )</th>
<th>( \frac{581}{t+63} )</th>
<th>( \text{inh} )</th>
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</thead>
<tbody>
<tr>
<td>124</td>
<td>0.435</td>
<td>0.265</td>
<td>8.728</td>
<td>11.348</td>
<td>2.807</td>
<td>23.58</td>
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<td>58.3</td>
<td>0.927</td>
<td>0.560</td>
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<td>19.426</td>
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<td>1.57</td>
<td>0.94</td>
<td>27.85</td>
<td>26.21</td>
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<td>39.23</td>
<td>6.14</td>
<td>115.22</td>
</tr>
</tbody>
</table>

\( \text{inh} \) \( 740 \) \( 10^6 \Delta \) \( 1002.406 - 0.36543 \text{inh} \) \( 740 \)

\[
\begin{align*}
22.92 & \quad 99.396 & \quad 99.402 & \quad +6 \\
41.97 & \quad 98.700 & \quad 98.706 & \quad +6 \\
60.97 & \quad 98.020 & \quad 98.012 & \quad -8 \\
80.36 & \quad 97.348 & \quad 97.303 & \quad -45 \\
95.89 & \quad 96.691 & \quad 96.736 & \quad +45 \\
115.11 & \quad 96.040 & \quad 96.034 & \quad -6
\end{align*}
\]

\[
6A - 417.22B = 46.195
\]

\[
417.22A - 34907.0820B = 2996.82439
\]

\[
A - 69.536667B = 7.6991667
\]

\[
A - 83.665889B = 7.1828397
\]

\[
14.129222B = 0.516327
\]

\[
\text{inh} = 2.32 \times 10^{-5}
\]
\[ f.N = \int A e^{-\frac{t}{\tau}} = \tau A \]

\[ \frac{f.N}{\tau} e^{-\frac{t}{\tau}} \]

\[ \int f \frac{n d\theta}{\tau} e^{-\frac{t-\theta}{\tau}} \]

\[ n(\theta) = \frac{N}{\tau} e^{\frac{\theta}{\tau}} \]

\[ \frac{f}{\tau} \int_{\theta}^{\infty} n(\theta) e^{\frac{\theta}{\tau}} d\theta \]

\[ \frac{T \tau}{T+\tau} \]

\[ \frac{f.N}{\tau+\tau} \int_{0}^{\frac{-\theta}{\tau}} e^{\frac{\theta}{\tau}} d\theta = \frac{f.N}{T+\tau} \]
\[ T = 60 \text{ sec} \]

\[
\frac{0.001110}{60.7} e^{-\frac{t}{0.7}} + \frac{0.004080}{66.5} e^{-\frac{t}{6.5}} + \frac{0.001228}{94} e^{\frac{-t}{143}} + \frac{0.000163}{2} e^{\frac{-t}{60.7}}
\]

\[ x \times 6.5 \quad x \times 3.4 \quad x \times 8.3 \]

No of neutrons left \(8 \times 10^{10}\) e

\[
\frac{1.11 \times 0.7}{60.7} \times 10^7 = \frac{4 \times 10^7}{66.5} \times 6.5
\]

\[
128000 \times e^{-\frac{t}{1.7}} + 3.99 \times 10^6 \times e^{-\frac{t}{6.5}} + 4.44 \times 10^6 \times e^{\frac{-t}{34}} + 946000 \times e^{\frac{-t}{83}}
\]

<table>
<thead>
<tr>
<th>Time (sec)</th>
<th>Neutrons</th>
</tr>
</thead>
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<td>0</td>
<td>128000</td>
</tr>
<tr>
<td>1</td>
<td>342100</td>
</tr>
<tr>
<td>2</td>
<td>293300</td>
</tr>
<tr>
<td>3</td>
<td>251500</td>
</tr>
<tr>
<td>4</td>
<td>215700</td>
</tr>
<tr>
<td>5</td>
<td>185000</td>
</tr>
<tr>
<td>6</td>
<td>158600</td>
</tr>
<tr>
<td>7</td>
<td>136000</td>
</tr>
<tr>
<td>8</td>
<td>116600</td>
</tr>
<tr>
<td>9</td>
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<tr>
<td>10</td>
<td>857300</td>
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<tr>
<td>15</td>
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<td>20</td>
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<td>25</td>
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<td>30</td>
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<td>1063</td>
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<td>393</td>
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<td>90</td>
<td>4</td>
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<td>540</td>
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946000
November 28, 1943

N's emitted from source (instantaneous calculation)

\[ N = 3.84 \times 10^6 \text{ Cd In Col at 12'' from Initial Source} \]

<table>
<thead>
<tr>
<th>KWH</th>
<th>0 min</th>
<th>1 min</th>
<th>2 min</th>
<th>3 min</th>
<th>4 min</th>
<th>5 min</th>
<th>6 min</th>
<th>Total</th>
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<tbody>
<tr>
<td></td>
<td>120</td>
<td>-</td>
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<td>-</td>
<td>8911</td>
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<td>1172</td>
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<td>-</td>
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<td>21.7</td>
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<td>-</td>
<td>-</td>
<td>1.013</td>
<td>49.2</td>
<td>-</td>
<td>-</td>
<td>1795</td>
<td>52.9</td>
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<tr>
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<td>209</td>
<td>123</td>
<td>52.9</td>
<td>24.5</td>
<td>2450</td>
<td></td>
</tr>
</tbody>
</table>

\[ \Delta \psi + \frac{k-1}{m^2} \psi = 0 \]

\[ \Delta \psi_n + \left( \frac{k-1}{m^2} + g_n \right) \varphi_n = 0 \]

\[ g_1, g_2, \ldots, g_n, \ldots \]

\[ \varphi_1, \varphi_2, \ldots, \varphi_n, \ldots \]
\[ \Delta \psi + (g - u) \psi = 0 \]

\[ u = \frac{1}{4} \Delta \psi + \lambda \sum \psi \]

\[ \psi = \psi_1 + \sum \lambda \psi_n a_m + \sum \lambda^2 b_m \psi_n \]

\[ g = g_1 + \lambda \gamma + \lambda^2 \chi \]

\[ \mu_{n-\frac{1}{2}} = \left( U - g_1 \right) \psi + \lambda \sum a_m \left( U - g_m \right) \psi_m + \lambda^2 \sum b_m \left( U - g_m \right) \psi_m = \]

\[ = (U + \lambda \nu - g_1 - \lambda \gamma - \lambda^2 \chi) \left( \psi + \lambda \sum a_m \psi_m + \lambda^2 \sum b_m \psi_m \right) \]

\[ \sum_{n=1}^{\infty} \psi_n \phi_n = (g_{m_1} - g_1) \sum a_m \psi_m + (U_1 - \nu) \psi_1 + (U_2 - \nu) \sum b_m \psi_m \]

\[ \sum_{n=1}^{\infty} \psi_n \phi_n = (g_{m_1} - g_1) \sum a_m \psi_m + (U_1 - \nu) \sum a_m \psi_m - \lambda \psi_1 \]

\[ \psi_{n+1} = \psi_n \]

\[ a_m = \frac{\psi_{n+1}}{g_{m_1} - g_m} \]

\[ \sum a_m \psi_{n+1} = \lambda \]

\[ g = g_1 + \lambda \nu \sum \frac{V_{in}^2}{g_{in} - g_m} \]
\[ v_{in} = A \Phi_1 \phi_n \]

\[ g = g_1 + A \phi_1^2 - A^2 \phi_1^2 \sum \frac{\phi_n^2}{g_m - g_1} = g_1 + A' \phi_1^2 \]

\[ A' = A - A^2 \sum \frac{\phi_n^2}{g_m - g_1} \]

Example: center of spherical pile

\[ \phi_n = \sin \frac{n \pi r}{R} \frac{\sin \frac{n \pi R}{2}}{r \sqrt{2 \pi R}} \]

\[ g_m = \frac{n^2 \pi^2}{R^2} \]

\[ \sum \frac{\phi_m^2}{g_m - g_1} = \sum \frac{n^2 \pi^2}{2 \pi R} \frac{\sin \frac{n \pi R}{2}}{R} (n^2 - 1) \]

\[ \int_0^R \frac{\sin \frac{n \pi r}{R}}{\alpha \pi R} \frac{\sin \frac{n \pi R}{2}}{R} \, dr = \frac{2}{\alpha \pi} \int_0^\alpha \sin \alpha \sin n \alpha \, d\alpha \]

\[ \sin n \alpha \sin \alpha = \frac{1}{2} \left[ \cos (n+1) \alpha + \cos (n-1) \alpha \right] \]

\[ \int \frac{\sin (n-1) \alpha}{n-1} - \frac{\sin (n+1) \alpha}{n+1} \]
\[ V_{1n} = \frac{G}{\pi} \left( \frac{\sin (n-1)\alpha - \sin (n+1)\alpha}{n-1} \right) \]

\[ \frac{G}{\pi} (\alpha - \sin \alpha \cos \alpha) - \frac{G^2 R^2}{\pi^4} \sum_{n=1}^{\infty} \frac{\sin (n-1)\alpha - \sin (n+1)\alpha}{n-1} \left( \frac{1}{n^2-1} \right) \]

\[ \frac{G}{2} - \frac{G^2 R^2}{2\pi^4} \]

\[ \sin \frac{n\alpha}{n} = \frac{\alpha - \frac{n^2 \alpha^3}{6}}{n} \]

\[ \frac{1}{\sqrt{5}} + \frac{1}{\sqrt{5}} \]

\[ \frac{1}{\sqrt{9}} + \frac{1}{\sqrt{9}} \]

\[ \frac{1}{\sqrt{15}} + \frac{1}{\sqrt{15}} + \frac{1}{\sqrt{35}} + \frac{1}{\sqrt{63}} + \frac{20}{99} \]

\[ l = \frac{1}{R} \]

\[ 1 - \frac{1}{R} = 0.834 \]

\[ R = 6 \]

\[ m_0 = 0.117 \]

\[ \frac{A(1 - \frac{1}{6})}{6} = 0.18 \]

\[ f = 0.886 = 1 - \frac{1}{0.256} \quad (\text{Col Ratio} - 1.1) \]

\[ = 1.028 - 0.256 \quad (\text{CLR}) \]

\[ \frac{\lambda m_0}{q} = 192 \quad (\text{Col Ratio} - 1.15) \]
\[ Q_1 = \frac{1.5356}{R \sqrt{H}} \int_0^{R_1} J_0 \left( \frac{2.405 r}{R} \right) 2 \, dx \int \frac{\pi x}{H} \, dx \]

\[ Q_1 = \frac{1.5356}{R \sqrt{H}} \int_0^{R_1} J_0 \left( \frac{2.405 r}{R} \right) 2 \, dx \int \frac{\pi x}{H} \, dx \]

\[ = \frac{2.405}{1.5356} \frac{q}{R \sqrt{H}} \left( \frac{R^2}{2.405^2} \right) \int_0^{2.405 \frac{R_1}{R}} J_0 (x) \, dx = \left( 1 - \cos \frac{n_x}{H} \right) \int_0^{2.405 \frac{R_1}{R}} J_0 (x) \, dx \]

\[ Q_1 = 1.5356 \frac{q}{R \sqrt{H}} \left( \frac{R^2}{2.405^2} \right) \int_0^{2.405 \frac{R_1}{R}} J_0 (x) \, dx \]

\[ \cos 169.5^\circ = 1.982 \]

\[ \frac{\pi H_1}{H} = 169.5^\circ \]

\[ 1.0524 \quad 7.6 \quad 8.76 \]

\[ \frac{H_1}{H} = 169.5^\circ \]

\[ 1.0524 \]
\[\sqrt{\frac{412.9 \cdot N}{\pi}} \cdot \sqrt{131.41 \cdot \sqrt{N}} = 11.463 \sqrt{N}\]

<table>
<thead>
<tr>
<th>(N)</th>
<th>(R_1)</th>
<th>(R = R_1 + 47.6)</th>
<th>(2.405 \frac{R_1}{R})</th>
<th>(\int \frac{2.405 R_1}{R} J_0(x) x , dx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>177</td>
<td>152.50</td>
<td>200.10</td>
<td>1.833</td>
<td>1.0665</td>
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<td>255.52</td>
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<td>341</td>
<td>211.68</td>
<td>259.28</td>
<td>1.963</td>
<td>1.1362</td>
</tr>
</tbody>
</table>

\[J_0(x) \times \int x \]

\[
\begin{array}{c|c|c|c|c}
0 & 0 & 0 & 0 & 0 \\
1 & 0.998 & 0.980 & 0.973 & 0.968 \\
2 & 2.933 & 2.842 & 2.762 & 2.697 \\
3 & 4.693 & 4.572 & 4.478 & 4.395 \\
4 & 6.168 & 6.070 & 6.003 & 5.950 \\
5 & 7.267 & 7.189 & 7.132 & 7.093 \\
6 & 7.652 & 7.580 & 7.530 & 7.492 \\
7 & 7.916 & 7.875 & 7.850 & 7.830 \\
8 & 8.053 & 8.025 & 8.012 & 8.003 \\
9 & 8.061 & 8.037 & 8.024 & 8.016 \\
10 & 7.937 & 7.923 & 7.911 & 7.903 \\
11 & 7.767 & 7.762 & 7.760 & 7.758 \\
12 & 7.286 & 7.292 & 7.299 & 7.306 \\
15 & 5.354 & 5.478 & 5.603 & 5.749 \\
16 & 4.478 & 4.643 & 4.819 & 5.014 \\
17 & 3.499 & 3.705 & 3.943 & 4.216 \\
18 & 2.429 & 2.701 & 3.055 & 3.489 \\
19 & 1.227 & 1.583 & 2.043 & 2.583 \\
20 & 0.060 & & & \\
\end{array}
\]
\[
\psi(n) = \frac{\psi_0}{\psi_n} = \frac{\psi_0^2}{\psi_n^2} = \frac{\psi_n}{\psi_0},
\]

\[
\psi_n = \psi_0 + \chi \frac{\partial \psi_0}{\partial x} + \ldots + \frac{1}{2} \chi^2 \frac{\partial^2 \psi_0}{\partial x^2} + \ldots
\]

\[
\frac{\psi_n}{\psi_0} = 1 + \frac{1}{6} \chi^2 \Delta \psi_0 = 1 - \frac{1}{\beta M^2} \approx 1 - \frac{1}{2} \approx 0.97
\]

\[
1 - 350 \times 10^6 \times 10^{-6} = 0.963
\]

\[
\Delta \nu = \frac{3}{\lambda \Lambda} \nu + \frac{3}{\lambda} q = 0
\]

\[
\Delta q = \frac{\partial q}{\partial t}
\]

\[
q = q_0 e^{t \Delta}
\]

\[
q(0) = p (1+\epsilon) Q + k \frac{\lambda \nu}{\Lambda} \nu
\]

\[
\Delta (\nu(q))
\]

\[
\theta = \nu \left[ \Delta - \frac{3}{\lambda \Lambda} + \frac{3}{\lambda} e^{t \Delta} \frac{k}{\Lambda} \right] + \frac{3}{\lambda} e^{t \Delta} p (1+\epsilon) \theta
\]

\[
\nu = \frac{\Lambda p (1+\epsilon) Q}{e^{-t \Delta} (1 - \frac{\lambda \nu}{3} \Delta) - k}
\]
\[ Q = 0, q_i \]
\[
\nu = \frac{\Lambda \rho (1+\varepsilon) Q_i}{e^{-t\Delta \left(1 - \frac{\lambda \Delta}{3} \right)} - \kappa}
\]

\[
\begin{align*}
Q_i &= 0.531 \, q \, R \sqrt{H} \times 1.982 \int \\
\psi(0) &= \frac{1.536}{\sqrt{H} \, R}
\end{align*}
\]

\[
Q_i \psi(0) = q \times \int x \times 0.531 \times 1.982 \times 1.536 = 1.6165 \, q \times \int
\]

\[
\frac{\nu}{\Lambda \rho (1+\varepsilon) q} = \frac{1.6165 \times \int}{e^{-t\Delta \left(1 - \frac{\lambda \Delta}{3} \right)} - \kappa}
\]

<table>
<thead>
<tr>
<th>N</th>
<th>1.6165</th>
<th>-Δ × 10^6</th>
<th>1 - \frac{\lambda \Delta}{3}</th>
<th>e^{-t\Delta}</th>
<th>4 \times 5</th>
<th>2/6-κ</th>
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<tr>
<td>177</td>
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<td>1.1081</td>
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<td>1.0411</td>
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<tr>
<td>cut</td>
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<td>1.0286</td>
<td>1.0356</td>
<td>1.0653</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
\[ \Lambda p (1+3) q = 1.1 \]

\[ q = \frac{1.11}{313 \times 0.886 \times 1.03} = 0.00389 \]

14.8 m/sec kg

12/1/1943

Breit Wigner formula for fission

\[ \sigma_f = \frac{2.6 \times 10^{-18}}{\sqrt{R \text{volts}} (K T \text{volts})} \frac{\Gamma_n \Gamma_f}{R^2} \]

Assume

\[ \sigma_f = 650 \beta \]

\[ \Gamma_n \Gamma_f = 4 \times 10^{-5} \]

\[ \frac{650 \times 10^{-24}}{2.6 \times 10^{-18}} \frac{1}{\sqrt{40}} \]
\[
\frac{\frac{650 \times 10^{-24}}{2.6 \times 10^{-18}}} \sqrt{1 \times \frac{1}{40}} \times 1^2 = \Gamma_n \Gamma_c = 4 \times 10^{-5}
\]

\[
\frac{3}{3000} = 10^{-4} \text{ sec}
\]

\[
\frac{15}{218} \times 10^{-4} = 8 \times 10^{-4} \text{ sec}
\]

\[
5 \times 10^{-7}
\]

\[
10^{-7} \times 3 \times 10^5 = 3 \times 10^{-2}
\]

\[
10^{-5}
\]

\[
3 \times 10^5 = 5
\]

\[
3 \times 10^5 \times 3 \times 10^{-8} = 10^{-2} \text{ cm/gam}
\]

\[
\frac{6.70 \text{ f kg sec}}{\sqrt{960}}
\]

\[
\text{Pa} 3B 400 \text{ KW}
\]

1 mg
\[ 1 + \frac{(\gamma - 1)\alpha}{1 - \gamma a} = \frac{1 - \gamma a - a}{1 - \gamma a} \]

\[ (1 - \varepsilon) = (1 - L_1)(1 - L_2) \]

\[ \alpha = \left[ (1 - L_1)(1 - L_2)f \right] \left( 1 + \frac{\gamma a}{1 - \gamma a} \right) \]

\[ \left[ (1 - L_1)(1 - L_2)f \gamma - 1 \right] \frac{1}{1 - \gamma a} = \alpha \]

\[ \nu f (1 - L_2) = \frac{1 - \gamma a}{1 - a} \frac{1}{\gamma \rho p} \]

\[ \left\{ \frac{1 - \gamma a}{1 - \gamma a} \frac{1 - L_1}{\gamma \rho - 1} \right\} \frac{1}{1 - \gamma a} \]

\[ \frac{1 - \varphi}{\varphi} + \frac{\nu (1 - a)}{1 - \gamma a} (1 - L_1)(1 - \rho) \]

\[ \frac{(1 - \varphi)(1 - \gamma a) + \varphi \nu (1 - a)(1 - L_1)(1 - \rho)}{\varphi (1 - \gamma a)} \]
Resonance captures between 2 Cd foils

\[ \frac{\lambda}{158} q \int \frac{\sigma}{E} \, dE = \mu v \sigma \text{ equivalent} \]

\[ q = \frac{\mu v}{\Lambda} \]

\[ \sigma_{\text{equivalent}} = \frac{\lambda}{158 \Lambda} \int \frac{\sigma}{E} \, dE \]

\[ \lambda = 2.6 \]

\[ \Lambda = 357 \]

\[ \sigma_{\text{equivalent}} = 0.046 \int \frac{\sigma}{E} \, dE \]

\[ 0.046 \sigma(R) \pi \frac{E}{R} = 0.1445 \frac{\Gamma \sigma(R)}{R} \]

\[ \Gamma \approx 8 \cdot 0.8 \approx 4.8 \]

\[ 0.04 \frac{\Gamma}{R} \]

\[ \frac{1}{10} \]

\[ \pi \times 2100 \frac{\Gamma}{35} \]

\[ \pi \times 2.6 \times 10^{-18} \frac{\Gamma}{R} \]

\[ 0.17 \]

\[ 0.035 \]

\[ 0.045 \]

\[ 0.019 \]

\[ 0.015 \]

\[ 0.075 \]
\[ S = 8 \times 1.25 = 10.00 \]

\[ 0.046 \sigma(R) \frac{\Gamma}{R} \pi n S \]

\[ n \sigma(R) \ll 1 \]

\[ \Sigma_{eqn} \ll 0.05 S \frac{\Gamma}{R} \sim \frac{1}{1000} S \]

\[ n = 2 \times 10^{-5} \text{gr/cm}^2 \]

\[ 2 \times 10^{-2} \text{gr/cm}^2 \]

\[ 2 \times 10^{-3} \text{gr/cm}^2 \]

\[ \frac{1}{50000} \]

\[ \frac{0.5}{20000} \]

\[ 1000 \times 2 \times 10^{-3} = 2 \times 10^{-1} \]

\[ \int_{0}^{\infty} \frac{dE}{E} = \ln \left( \frac{1 - e^{-\sigma n}}{n} \right) \]

\[ \int \frac{1 - e^{-\sigma n}}{n} \frac{dE}{E} = \frac{\Gamma}{Rn} \left[ \left( 1 + \frac{E^2}{\Gamma^2} \right) \ln \left( \frac{1 + \frac{E^2}{\Gamma^2}}{1 + \frac{E^2}{\Gamma^2}} \right) \right] dE \]

\[ \sigma \approx \frac{\sigma(R)}{1 + \frac{E^2}{\Gamma^2}} \]

\[ \sigma(R) n = \Sigma(R) \]
\[
\frac{1}{nR} \int_0^\infty \left(1 - e^{-\frac{\Sigma(R)}{1+x^2}}\right) dx
\]

\[\pi \Sigma \rightarrow 21\pi \Sigma\]

\[
\frac{1}{\pi} \int \frac{dx}{1+x^2} e^{-\frac{\Sigma}{1+x^2}} = \sqrt{\frac{\pi}{\Sigma}} e^{-\frac{\Sigma}{2}} J_0 \left(i \frac{\Sigma}{2}\right) = \left\{ \begin{array}{l}
1 - \frac{\Sigma}{\pi} + \ldots
\end{array} \right.\]

\[
\sqrt{\frac{\pi}{\Sigma}} d\Sigma = 21\pi \Sigma
\]

\[
\frac{2}{nR} \sqrt{\pi \sigma(R)n}
\]

\[
\frac{2 \sqrt{\pi \sigma(R)n}}{\pi \sigma(R)n} = \frac{2}{\sqrt{\pi}} \frac{1}{\sqrt{\sigma(R)n}}
\]

\[\sigma_T + 0.046 \int \sigma \frac{dE}{E} \times \frac{2}{\sqrt{\pi} \sqrt{\sigma(R)n}}
\]

\[\frac{1}{2} \sqrt{\frac{\sigma(R)n}{\pi}} \geq 2 \frac{F}{V}
\]

\[
\sigma(R)n = \frac{4}{\pi} F^2
\]
\[
\frac{0.046 \times 8.17 \times 10^{-18} \text{ in}^2}{2.6 \times 10^{-18}} = 1.44 \frac{R}{T} \sqrt{\frac{R \cdot E \cdot T}{}}
\]

\[
\frac{0.026 \times R^{3/2}}{T}
\]

\[
\frac{2500 \text{ m/sec}}{1/2} \frac{1.68 \times 10^{-24} \times 2.5^2 \times 10^{10}}{1.6 \times 10^{-12}}
\]

\[
= 0.328
\]

\[
\text{Res. effect} = 0.026 \frac{R^{3/2}}{T}
\]

\[
\text{thermal effect}
\]
X-ray identification of fission products
Assume emission of one quantum K line
per disintegration

\[ h\nu = \frac{3}{4} (Z-1)^2 \times 13.5 \text{ eV} = 10.1 \times (Z-1)^2 \]

20,000 eV

\[ \lambda = \frac{6.62 \times 10^{-27} \text{ kgm/s}}{2 \times 4.8 \times 10^{-28} \text{ kgm/s} \times 20000 \times 1 \times 10^{-12}} \]

\[ \Delta = 8.69 \times 10^{-10} \]

\[ \Delta \cdot \frac{20000}{1.6 \times 10^{-12}} \]

\[ \lambda_{20000} = \frac{1.62 \times 10^{-27} \times 3 \times 10^{10}}{20000 \times 1 \times 1.6 \times 10^{-12} \times 10^{3} \text{ A}^{-1}} \]

\[ \lambda_{20000} = 1.623 \text{ Å} \]

\[ 45.1936 \times 0.10250 = 4.61 \]

\[ D = 0.180 \times 20 = 3.6 \text{ Å} \]

\[ 5 \text{ Å} \]

\[ 20 \text{ cm} \]
CaCO₃  6.36 Å  \( a = 46.6° \)
Calcite  3.03 Å
Mica  9.85
Quartz (110)  3.33 Å
NaCl  5.62 Å
LiF  4.01 Å

Diagram:
- Crystal
- Pb shield
- Film
- Deposit
According to Miss McNair, a good Molybdenum K radiation picture can be obtained with 1001 Coulomb at 50000 volts. Assuming yield \( \frac{1}{1000} \) this is \( 6 \times 10^{12} \) disintegrations or about 50 mC per hour.

Example: 5 kg molybdenum nitrate.

a) Dissolve in ether and eliminate most of water.

b) Irradiate powdery etherate with 100 kW.

c) Dissolve in ether and extract with 20 cc water (86 min).

Precipitate Ba as sulphate (Dilute to 150 cc, add 10 mg Ba(NO₃)₂, add H₂SO₄, centrifuge, or 60 min. Te). Add telluric acid. Reduce with SO₂ and dilute in 2 N nitric acid. Precipitate with HF.

It should be possible to collect \( 5 \times 10^{13} \) disintegrations or perhaps \( 10^{12} \) X-ray photons.
December 24 1947

Internal conversion

\[ Z \beta \rightarrow (Z+1)^* \xrightarrow{\gamma} (Z+1)^* \xrightarrow{X-ray} Z \]

Isomeric transition

\[ Z^* \xrightarrow{\gamma} e \xrightarrow{X-ray} Z \]

\[
\mu \text{ sec} = \frac{x}{12.7}
\]

\[
eV = \frac{5228}{15748x}
\]

\[
\begin{align*}
10 & \text{, } 0.7874x \\
5.220 & \\
5.200 & \\
5.220 & \left(1.602 \times 10^{-12}\right) \\
5.240 & \\
5.400 & \\
5.290 & \\
1 \times 10^{-24} & = V/m^2 \\
3.204 & \\
1.39 & \\
1.13 & \\
1.26 & \\
1.43 & = \frac{1.65 \times 10}{0.13 + 1.05} \\
0.15 & = \left(\frac{1.06}{f}\right)
\end{align*}
\]
\[ 5.5 \times 10^6 = 1.55 \times 10^6 \text{ barns} \times \frac{\text{m}}{\text{sec}} \]

\[ 5.25 \times 10^6 = 1.43 \times 10^6 \]

\[ \frac{10.6}{12.7} \]

\[ 1.3075 \]

\[ 10.6 \cdot 10^{-4} \]

\[ 10 \cdot 12.7 = 1.43 \times 10^6 \]

\[ 6.155 - 0.835 \]

<table>
<thead>
<tr>
<th>R(x)</th>
<th>1.575x</th>
<th>R(eV)</th>
<th>( \Gamma )</th>
<th>( E_0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.8</td>
<td>4.6935</td>
<td>1.06</td>
<td>.27</td>
<td>1.65 x 10^6</td>
</tr>
<tr>
<td>23.4</td>
<td>3.6855</td>
<td>1.08</td>
<td>.19</td>
<td>1.25 x 10^6</td>
</tr>
<tr>
<td>20.35</td>
<td>3.2051</td>
<td>3.12</td>
<td>.4</td>
<td>.90 x 10^6</td>
</tr>
<tr>
<td>17.4</td>
<td>2.7405</td>
<td>9.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \frac{\pi \delta V \Gamma}{\Delta} = 4 \times 10^6 \]

\[ \Delta = 1 \]

\[ \Gamma = 0.3 \]

\[ V_{eV} = 6.3 \times 10^5 \]

\[ 2.6 \times 10^6 \frac{\Gamma_m \Gamma_e}{R[\text{m}(\text{eV})]} \]

\[ \frac{\Gamma_m \Gamma_e}{\Gamma^2 + \Delta \omega^2} = \frac{2}{3} \]

\[ \frac{\Gamma_m \Gamma_e}{\Gamma^2 + \Delta \omega^2} = \frac{2}{3} \]

\[ \frac{2}{3} \cdot \frac{\pi h^2}{m^2 \sqrt{R}} = 4.56 \times 10^{-12} \]

\[ m^{3/2} \sqrt{R} = 3.5 \]
December 27, 1943 (Expt performed 12/26)

Slowing down of fission neutrons in water

U-plate 6" φ
0.5 cm thick
1690 grams

Col in Col standard detector

Irradiation about 10 KWH

<table>
<thead>
<tr>
<th>$x$ cm</th>
<th>$1/N$ initial</th>
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<tr>
<td>3</td>
<td>2.462 - 5</td>
</tr>
<tr>
<td>6</td>
<td>1.350 - 2</td>
</tr>
<tr>
<td>9</td>
<td>650.6 - 1</td>
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<tr>
<td>14.9</td>
<td>113.6 - 5</td>
</tr>
<tr>
<td>20.9</td>
<td>28.9 - 2</td>
</tr>
</tbody>
</table>
\[ \int_{r_{1}}^{r_{2}} f(r) \, r \, dr \]

\[ \begin{align*}
R &= 3'' = 7.62 \\
5.75, 15.8^2, 21.57, 21.4
\end{align*} \]

<table>
<thead>
<tr>
<th>( n )</th>
<th>( r_{2}f )</th>
<th>( r^{2}f )</th>
<th>( r^{4}f )</th>
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<td>0</td>
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<td>276</td>
<td>276</td>
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<tr>
<td>28</td>
<td>6.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \begin{align*}
3.\overline{5}6744 \div 726 &= 529.69 \div 1019800 \\
&= 631.6760
\end{align*} \]

\[ \Rightarrow r = 17.4 \]
\[ \int_{E} \pi(E) \, dE = 2.213 \]

\[ \int \frac{\pi(E)}{E} \, dE = 332 \]

\[ \bar{E}^2 = \frac{332}{2.213} = 150.5 \]

\[ \begin{array}{c}
14.16 (\%) \\
34.3 \\
35.6 \\
1856 \\
174 \\
20\% \quad 27\% \\
\end{array} \]

\[ \begin{array}{c}
\text{LiF} \\
27.4 \quad 15.9^\circ \quad 285 \\
1.52 \quad 8.75^\circ \quad 1.54 \\
1.117 \quad 6.72^\circ \quad 1.17 \\
0.82 \quad 4.70^\circ \quad 0.82 \\
\end{array} \]

\[ \lambda = 2d \cos \theta \]

\[ \frac{\lambda}{2d} \]
\[ Q = 1.8 \times 10^{-3} \text{ acre} \]
Br 80 44 hr
Sr 85 70 min
Rh 4.2 min
12/29/1940

In \( \lambda (k\alpha) = 0.513 \, \text{Å} \) \( \theta = 5.23^\circ \)

Au \( \lambda (k\alpha) = 0.182 \, \text{Å} \) \( \theta = 1.85^\circ \)

NaCl \( 2d = 5.627 \, \text{Å} \)

\[
\frac{.08 \times 80}{115} = .055 \\
\frac{.3 \times 50}{197} = .077
\]

13.3
3.6
$\phi 3.5''$ two faces coated 3gr metal

$\sim 64 \text{ cm}^2$

47 $\mu$g/cm²

\[ \begin{array}{ccc}
\text{MeV} & \text{Fissions/R} & \text{No of fissions} \\
5.43 & 1.19 & 1/5300 \text{ sec} \\
5.66 & 1.72 & 7/7700 \text{ sec} \\
5.78 & 2.86 & 8/5415 \text{ sec} \\
6.00 & 4.71 & 13/5652 \\
6.23 & 7.60 & 12/2711 \\
6.51 & 11.68 & 20/409 \\
6.89 & 19.9 & 60/ \\
7.28 & 27.9 & 90/ \\
7.87 & 31.8 & 108/160 \\
8.44 & 35.4 & 156/156 \\
9.01 & 26.0 & 38/ \\
9.17 & 20.0 & 40/ \\
8.66 & 38.1 & 40/ \\
9.77 & 44.4 & 40/ \\
10.87 & 66.9 & 40/ \\
11.96 & 113.1 & 80/ \\
12.61 & 160 & 60/ \\
\end{array} \]

Thin W target

\[ \frac{7700 \times 2 \times 6}{10 \times 10^20} \]

\[ \frac{7700 \times 2 \times 6}{10^{20}} \]

\[ \frac{6.3 \times 10^{-27}}{10^4} \]
<table>
<thead>
<tr>
<th>MeV</th>
<th>Pulsec/R</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.86</td>
<td>0.20</td>
</tr>
<tr>
<td>6.0</td>
<td>0.79</td>
</tr>
<tr>
<td>6.12</td>
<td>0.81</td>
</tr>
<tr>
<td>6.25</td>
<td>3.76</td>
</tr>
<tr>
<td>6.69</td>
<td>11.2</td>
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<td>20.6</td>
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<tr>
<td>7.87</td>
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<td>8.44</td>
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</tr>
<tr>
<td>10.16</td>
<td>10.3</td>
</tr>
<tr>
<td>10.74</td>
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</tr>
<tr>
<td>8.66</td>
<td>14.7</td>
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<td>9.77</td>
<td>14.3</td>
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<td>10.87</td>
<td>19.8</td>
</tr>
<tr>
<td>11.96</td>
<td>16.0</td>
</tr>
<tr>
<td>12.61</td>
<td>13.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Element</th>
<th>Thresholds</th>
<th>MeV</th>
<th>From waxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>C&quot;</td>
<td>21 mm</td>
<td>18.7 - 19.4</td>
</tr>
<tr>
<td>N</td>
<td>N/13</td>
<td>10 mm</td>
<td>11.1 ± 0.5</td>
</tr>
<tr>
<td>O</td>
<td>O/15</td>
<td>2.1 m</td>
<td>16.3 ± 0.4</td>
</tr>
<tr>
<td>Fe</td>
<td>Fe/50</td>
<td>9 m</td>
<td>14.2 ± 0.4</td>
</tr>
<tr>
<td>Cu</td>
<td>Cu/62</td>
<td>10.3</td>
<td>10.9 ± 0.5</td>
</tr>
<tr>
<td>Zn</td>
<td>Zn/63</td>
<td>3.9 m</td>
<td>11.6 ± 0.4</td>
</tr>
<tr>
<td>Se</td>
<td>Se/59121</td>
<td>17 m</td>
<td>9.8 ± 0.5</td>
</tr>
<tr>
<td>Ho</td>
<td>Ho/41095</td>
<td>17 m</td>
<td>13.5 ± 0.4</td>
</tr>
<tr>
<td>Ag</td>
<td>Ag/108</td>
<td>2.5 m</td>
<td>9.3 ± 0.5</td>
</tr>
<tr>
<td></td>
<td>Ag/106</td>
<td></td>
<td>9.5 ± 0.5</td>
</tr>
</tbody>
</table>
Counter 7 cm long, 16 cm φ
Foil wrapped around

12/31/42

\[ T = \frac{4}{\sqrt{\pi}} \int_0^\infty x^2 e^{-x^2 - \frac{x^2}{2}} \, dx \]

<table>
<thead>
<tr>
<th>x</th>
<th>x^2</th>
<th>-x^2</th>
<th>x^2 e^{-x^2}</th>
<th>e^{-x^2}</th>
<th>\frac{x^2}{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.0000</td>
<td>0.0000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.2</td>
<td>0.04</td>
<td>0.9608</td>
<td>0.0384</td>
<td>2.718</td>
<td>0.01413</td>
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<tr>
<td>0.4</td>
<td>0.16</td>
<td>0.8521</td>
<td>0.1363</td>
<td>1.649</td>
<td>82.66</td>
</tr>
<tr>
<td>0.6</td>
<td>0.36</td>
<td>0.6977</td>
<td>0.2512</td>
<td>1.396</td>
<td>179.94</td>
</tr>
<tr>
<td>0.8</td>
<td>0.64</td>
<td>0.5273</td>
<td>0.3375</td>
<td>1.284</td>
<td>262.85</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1.3679</td>
<td>0.3679</td>
<td>1.0215</td>
<td>30.118</td>
</tr>
<tr>
<td>1.2</td>
<td>1.44</td>
<td>1.23693</td>
<td>0.3412</td>
<td>1.1812</td>
<td>288.83</td>
</tr>
<tr>
<td>1.4</td>
<td>1.96</td>
<td>1.4086</td>
<td>0.2761</td>
<td>1.1535</td>
<td>239.36</td>
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<tr>
<td>1.6</td>
<td>2.56</td>
<td>0.7730</td>
<td>0.1979</td>
<td>1.1333</td>
<td>174.65</td>
</tr>
<tr>
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<td>3.24</td>
<td>0.3916</td>
<td>0.1269</td>
<td>1.1175</td>
<td>113.52</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>0.1832</td>
<td>0.0733</td>
<td>1.1051</td>
<td>66.33</td>
</tr>
<tr>
<td>2.2</td>
<td>4.84</td>
<td>0.0791</td>
<td>0.0383</td>
<td>1.0950</td>
<td>34.98</td>
</tr>
<tr>
<td>2.4</td>
<td>5.76</td>
<td>0.315</td>
<td>0.0181</td>
<td>1.0869</td>
<td>16.65</td>
</tr>
<tr>
<td>2.6</td>
<td>6.76</td>
<td>0.16</td>
<td>0.0099</td>
<td>1.0799</td>
<td>7.21</td>
</tr>
<tr>
<td>2.8</td>
<td>7.84</td>
<td>0.39</td>
<td>0.0059</td>
<td>1.0739</td>
<td>2.89</td>
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<td>3</td>
<td>9</td>
<td>1.000123</td>
<td>0.11</td>
<td>1.0689</td>
<td>103</td>
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<tr>
<td>3.2</td>
<td>10.24</td>
<td>0.000035</td>
<td>0.04</td>
<td>1.064</td>
<td>38</td>
</tr>
<tr>
<td>3.4</td>
<td>11.56</td>
<td>0.9</td>
<td>1</td>
<td>1.0605</td>
<td>9</td>
</tr>
<tr>
<td>3.6</td>
<td>12.96</td>
<td>2</td>
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<td>3.8</td>
<td>14.44</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \sum \text{small} \quad T = 1 - \frac{2}{\sqrt{\pi}} \sum + \sum^2 + \ldots \]

\[ \sum \text{large} \quad T = \frac{4}{\sqrt{3} \cdot 2^{1/3}} \sum^{2/3} e^{-\frac{3}{2^{1/3}} \sum^{1/3}} \]

\[ \frac{\sqrt{\pi}}{2} \]

\[ Z = 12 + 4 + 6 + 8 + 10 + 12 \]

\[ T(2) = 8063 \]
| e^{-2x} | \Sigma | \cdot | \cdot | 0.5 \cdot | \cdot | \cdot | 0.5 \cdot | \cdot | 0.5 \cdot | \cdot | 0.5 \cdot | \cdot | 0.5 \cdot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 |
| 0.367 | 0.014 | 0.005 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.606 | 0.082 | 0.050 | 0.030 | 0.018 | 0.012 | 0.009 | 0.006 | 0.004 | 0.003 | 0.002 | 0.001 | 0.000 | 0.000 |
| 0.716 | 0.179 | 0.128 | 0.092 | 0.066 | 0.047 | 0.033 | 0.023 | 0.016 | 0.011 | 0.007 | 0.004 | 0.002 | 0.001 |
| 0.778 | 0.262 | 0.194 | 0.124 | 0.086 | 0.058 | 0.039 | 0.026 | 0.017 | 0.012 | 0.008 | 0.005 | 0.003 | 0.002 |
| 1.181 | 0.301 | 0.246 | 0.182 | 0.128 | 0.087 | 0.056 | 0.037 | 0.024 | 0.016 | 0.011 | 0.007 | 0.004 | 0.002 |
| 1.845 | 0.288 | 0.244 | 0.198 | 0.152 | 0.111 | 0.074 | 0.049 | 0.032 | 0.022 | 0.014 | 0.009 | 0.005 | 0.003 |
| 2.249 | 0.239 | 0.202 | 0.157 | 0.112 | 0.074 | 0.049 | 0.032 | 0.022 | 0.014 | 0.010 | 0.006 | 0.004 | 0.003 |
| 3.286 | 0.186 | 0.154 | 0.113 | 0.074 | 0.049 | 0.032 | 0.022 | 0.014 | 0.010 | 0.006 | 0.004 | 0.003 | 0.003 |
| 3.978 | 0.134 | 0.105 | 0.073 | 0.049 | 0.032 | 0.022 | 0.014 | 0.010 | 0.006 | 0.004 | 0.003 | 0.003 | 0.003 |

\[
\begin{array}{cccccccccc}
535642 & 438152 & 362112 & 301600 & 252778 & 212980 & 180264 \\
.35709 & .29210 & .24141 & .20107 & .16853 & .14199 & .12018 \\
.92555 & .89312 & .82890 & .7583 & .68680 & .61382 & .5409 \\
.93947 & .94309 & .94656 & .95099 & .95543 & .95987 & .96431 \\
\end{array}
\]

\[
\begin{array}{cccccccccc}
T(e^{-2x}) & \log_{10}(e^{-2x}) & \frac{1}{e^{-2x}} & \frac{1}{
\begin{aligned}
58 \\
157 \\
30 \\
525
\end{aligned}
\]

\[
\begin{array}{cccccccccc}
\Sigma & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
.9268 & .9599 & .9880 & 1.0125 & 1.0343 & 1.0543 & 1.0729 \\
\end{array}
\]

\[
\begin{array}{cccccccccc}
x - x_5 & 1 - 5x & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
669 & 504 & 669 & 134 & 31 & 15 & 535 & 459 & 525
\end{array}
\]
1/6/44

\[
\text{Wiggling of } k \hspace{1cm} \frac{dh}{dt} = \frac{E}{h_0} \hspace{1cm} \frac{d\ell}{dt} = \frac{3}{2} \ell
\]

1/27/44

\[
\gamma \text{ from heating}
\]

8050 cal
12640

Atoms of 49

3.59 acts/min cal

\[
\frac{3.59 \times 10^{-6} \times 6.023 \times 10^{24}}{71000 \times 239} = 1.274 \times 10^7
\]

Duckworth

Phys Rev

1 year ago

A + B

15A + 105B = 234.5
105A + 1015B = 1719.7

A + 2B = 15.633

\[
A = \frac{574.9}{4260} = 13.68
\]

B = 0.2793

\[
4.82 - \frac{13.68}{7.86}
\]
\[ \sigma = 13.68 + 2.793 \left( \frac{10^6}{V} - \frac{172.5}{5.4} \right) \frac{5.4}{10^6} \]

\[ \sigma = \frac{15080}{V} + 8.86 \]

\[ \begin{array}{c|c|c|c|c|c|c|c}
\hline
4.7 & 4.85 & & & & & \\
140 & 3.13 & & & & & \\
141 & 3.03 & & & & & \\
\hline
17 & & & & & & \\
\hline
\end{array} \]

\[ (85 + 1n = 2n + 141 + 93) \]

\[ \begin{align*}
125.49 & + 42.72 + 57.38 \\
\hline
= 216.7 & \times 0.931 = 201.7
\end{align*} \]

\[ \begin{align*}
\text{KE of frame} & = 170 \\
\text{Inst. p rays} & = 10 \\
\beta \text{ energies} & = 6 \\
\nu \text{ energies} & = 8 \\
\gamma \text{ energies} & = 4 \\
\text{KE of 2 neut} & = 4 \\
\hline
\text{short heating} & = 170 \\
\end{align*} \]

\[ \begin{align*}
\text{fiss} & = 1.38 \times 10^{-11} \\
\frac{\text{cal}}{\text{fiss}} & = 189 \\
\text{capture} + & = 189 \\
\text{fiss} & = 1.923
\end{align*} \]
1.09 \times 9.23 = 10.06

1.006 = \frac{y}{\eta} - 1 - \alpha + 0.98 (1 - \rho) (1.09 y - 0.09)

2.006 + \alpha = 0.758 y + 0.1078 (1.09 y - 0.09)

\frac{2.016 + \alpha}{0.875} = 2.30 + 1.1 \alpha

2.14

2.14

2.28

\frac{2.017 + \alpha}{0.86} = 2.28 + 1.1 \alpha

1/20/44

Stripping at Clinton

22 lb

5a \times 10^{-8} = -0.42335 lb

\frac{\Delta}{\delta} = 9.3 \times 10^{-8}

\Delta n + \frac{k-1}{2} n + \frac{\Lambda}{\nu M^2} q = 0
\[ J_0 + AY_0\left(\sqrt{\frac{1}{c^2} - \frac{\pi^2}{H^2}}\right) = \begin{cases} 0 & \text{for } r = r_0 \\ 0 & \text{for } r = R \end{cases} \]

\[ Y_0(\alpha) = \frac{2}{\pi} \left[ \alpha + \log \frac{\alpha}{2} \right] \quad J_0'(102.405) = -0.519 \]

\[ Y_0(2.405) = 0.510 \]

\[ \sqrt{\frac{1}{c^2} - \frac{\pi^2}{H^2}} = \alpha \]

\[ 1 + \frac{2}{\pi} A \log \frac{\alpha r_0}{3.56} = 0 \]

\[ 0.519 (\alpha R - 2.405) + 0.510 A = 0 \]

\[ 2.447 + A = 1.018 \alpha R \]

\[ 2.447 = \frac{\pi}{2 \log \frac{\alpha r_0}{3.56}} + 1.018 \alpha R \]

\[ 2.405 = \alpha R + \frac{1.544}{\log \frac{\alpha r_0}{3.56}} \]

\[ \alpha = \frac{2.405}{R} \quad \frac{1.544}{R \log \frac{0.676 r_0}{R}} = \sqrt{A - \frac{\pi^2}{H^2}} \]
\[ \Delta = \frac{\pi^2}{H^2} + \frac{5.784}{R^2} + \frac{7.43}{R^2 \log \frac{1.48R}{r_0}} \]

\[ \text{1094x10}^{-6} = \frac{\pi^2}{718^2} + \frac{5.784}{R^2} \]

\[ \text{19.2x10}^{-6} \]

\[ \frac{578.4 \times 10^4}{81.2} \]

\[ 7.123 \times 10^4 = R^2 \]

\[ R = 2.67 \]

\[ \log \frac{395.2}{r_0} = \frac{1}{9.3 \times 10^{-6}} \frac{7.129 \times 10^4}{7.43} \]

\[ \log \frac{395.2}{r_0} = \frac{112}{6} = \frac{106}{86} \]

\[ n = 2 \log \frac{r_0}{r} \]

\[ \frac{\nu L^2}{\Lambda} \]

\[ \frac{\nu L^2}{\Lambda} = \frac{2\pi A}{2\pi \Lambda} \frac{\ln \frac{r_2}{r_1}}{} \]

\[ \frac{L^2}{\Lambda} = \frac{3\pi}{110} = \sigma \]

\[ \frac{635}{313} \cdot \frac{2\pi}{110} = 0.116 \]

\[ 0.00356 S \]

\[ S = 330 \text{ cm}^2 \]
\[ q = \frac{c_p \Delta T}{r} \]

\[ T = T(r) + \varepsilon \]

\[ \frac{c_p \varepsilon}{K} = T'' + \frac{2}{r} T' = \frac{1}{r} \left( rT \right)'' \]

\[ \frac{c_p \varepsilon}{K} \left( \frac{r^2}{2} + a_2 A \right) = \left( rT \right)' \]

\[ \frac{c_p \varepsilon}{K} \left( \frac{r^3}{6} + A_2 + B \right) = rT \]

\[ T = \frac{c_p \varepsilon}{K} \left( \frac{B}{r^2} + A + \frac{r^2}{6} \right) \]

\[ T = \frac{c_p \varepsilon}{6K} \left( \frac{2b^3}{r} + r^2 + \frac{3b^2}{2} \right) + \varepsilon \]

\[ \frac{B}{b^2} = \frac{b}{3} \]

\[ B = \frac{b^3}{3} \]
\[ T = \frac{c P e}{6k} \left( \frac{2b^3}{r^2} + r^2 - 3b^2 \right) + \varepsilon t \]

\[ \frac{\text{cm} \text{m} \text{T}_0}{T} = \frac{4\pi \varepsilon}{\kappa} \left( \frac{\frac{1}{2}b^3}{\kappa^2} - \frac{a^3}{\kappa^2} \right) \frac{c P e}{3\kappa} \]

\[ \frac{\text{cm} \text{m} \text{T}_0}{T} = \frac{4\pi}{3} \left( b^3 - a^3 \right) c P e \]

Example:

\( b = 13 \text{ cm} \)
\( a = 4 \text{ cm} \)
\( T = 600 \text{ sec} \)
\( \text{cm} \text{m} \text{T}_0 = 76 \)
\( T_0 = 1 \)
\( \rho = 1.6 \)
\( c = 17 \)
\( k = 0.3 \)
\[ \frac{4\pi}{3} \left( b^3 - a^3 \right) = 8435 \]
\[ \frac{2197}{64} = 33.33 \]
\[ \frac{1277}{430} = 2.96 \]
\( c \rho = 1272 \)
\( \frac{127}{2430} = 0.523 \)
\( \varepsilon = 5.23 \times 10^{-5} \)
\[ \frac{c P e}{6k} = \frac{1272 \times 5.23 \times 10^{-5}}{6 \times 3} = 7.90 \times 10^{-6} \]

\[ T = 7.90 \times 10^{-6} \left[ \frac{4394}{r^2} + r^2 - 507 \right] + 5.23 \times 10^{-5} t \]

\[ T = \frac{0.347}{r^2} + 7.9 \times 10^{-6} r^2 - .00400 + 5.23 \times 10^{-5} t \]
\[ T(4) = 100.87 + 0.0049 - 0.0040 = 0.0066 + 5.23 \times 10^{-5} \]

\[ T(7) = 50 \quad \Delta 40 \quad 14 + 11 \]

\[ T(10) = 35 \quad 8 \quad 40 \quad 3 + 11 \]

\[ T(13) = 27 \quad 13 \quad 40 \quad 0 + 11 \]

\[ \frac{0.0015}{300} = 5 \times 10^{-6} \]

\[ 5 \times 10^{-6} \]

\[ \frac{2.6 \times 10^{-18}}{\sqrt{E}} \frac{\Gamma_m \Gamma_c}{\Gamma^2 + (E-R)^2} = \sigma \]

\[ \int \sigma \sqrt{E} \, dE = \frac{2.6 \times 10^{-18}}{\sqrt{\pi}} \frac{\Gamma_m \Gamma_c}{\Gamma} = \pi \]

\[ = \frac{2.6 \times 10^{-18} \pi}{\sqrt{R}} \Gamma_m = 8.2 \times 10^{-18} \frac{\Gamma_m}{\sqrt{R}} \]

\[ 3270 \int \frac{dE}{\Delta} + \ldots \]

\[ 3270 \times 0.061 \times \pi = 6.26 \]

\[ \frac{\Gamma_m}{\sqrt{R}} \approx 6 \times 10^{-4} \]

\[ \text{Level leak} -4 -1.5 -6.5 -4 \]

\[ \text{tot} \]
\[
\frac{33.7529}{8.5} = 3.97
\]

29.99

\[
\begin{align*}
\text{B}^{10} \ (n, \alpha) \ \text{Li}^7 & \quad Q = 2.85 \quad (1.81, 1.0) \quad 0.86 \\
\text{Li}^6 \ (n, \alpha) \ \text{H}^3 & \quad 4.57 \quad (1.96, 2.61) \quad 1 \\
\text{N}^{14} \ (n, p) \ \text{C}^{14} & \quad 0.62 \\
\text{O}^{17} \ (n, \alpha) \ \text{C}^{14} & \quad 1.79 \\
\end{align*}
\]

\[
29.99 \times 602 = 0.0643 \\
\left\{ \begin{array}{c}
\text{tot} \quad 1.71 \\
\text{abs} \quad 0.49 \end{array} \right\} 7.17 \\
\left\{ \begin{array}{c}
\text{tot} \quad 5.46 \\
\text{abs} \quad 5.29 \end{array} \right\}
\]

15.60

\[
\left\{ \begin{array}{c}
10 \ \text{cc} \end{array} \right\}
\]
2/1/44

With new data from Dempster

\[
\begin{align*}
25 + 'n &= 2 \beta + 2 \gamma + 214 \text{ MeV} \\
\end{align*}
\]

<table>
<thead>
<tr>
<th>K.E. of fragments</th>
<th>174</th>
<th>174</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant γ rays</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>γ of radioactivities</td>
<td>5</td>
<td>2</td>
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<tr>
<td>β activities</td>
<td>7</td>
<td>4</td>
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<tr>
<td>neutrons</td>
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<td>0</td>
</tr>
<tr>
<td>K.E. of 2 neutrons</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>New capture</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
\text{fiss} &= \frac{4.185 \times 10^{-7}}{1.98 \times 1.602 \times 10^{-6}} = 1.31 \times 10^{11} \\
\text{cal} &= 1.27 \times 10^{11} \\
\text{fiss} &= \frac{1.27}{1.31} = 0.97
\end{align*}
\]

\[
\begin{align*}
\alpha + 2.057 &= \frac{7}{\eta} \left( \alpha - \alpha + 0.98 \times 1.2 \right) (0.09 \eta - 0.09) \\
\alpha &= 2.068 + \alpha \\
y &= \frac{2.068 + \alpha}{0.886} = 2.33 + 1.1\alpha
\end{align*}
\]
\[ \rho u \, du + dp = 0 \]
\[ \rho u \, s = Q \]
\[ \frac{\rho u \, s}{\rho \, s} = \rho \frac{du}{dt} = -\frac{dp}{dx} - \frac{1}{2\mu} \frac{p}{D} \frac{\partial}{\partial x} \left( \frac{\rho u^2}{2} \right) \]
\[ \frac{du}{dt} = u \frac{du}{dx} \]
\[ \rho u \, du + dp = -F \, dx \]
\[ Q \, \frac{du}{s} + dp = -F \, dx \]
\[ \int \frac{du}{s} = \int \frac{u \, ds}{s^2} = \left( \frac{u}{s} \right) \]
\[ \int F \, dx = \int u \, d \frac{1}{s} \]
\[ \rho u \text{d}u + dp = 0 \]

\[ \rho u s = Q \]

\[ p = p_0 \left( \frac{\rho}{\rho_0} \right)^k \]

\[ dp = \frac{\rho_0}{\rho^k} k \rho^{k-1} \text{d}p \]

\[ u \text{d}u + \frac{kr_0}{\rho_0^k} \frac{dp}{\rho^{2-k}} \]

\[ \frac{u^2}{2} + \frac{k \rho_0}{\rho_0^k} \frac{p_0^{k-1}}{k-1} = \frac{u_0^2}{2} + \frac{k}{k-1} \frac{p_0}{\rho_0} = \frac{u_0^2}{2} + \frac{k}{k-1} \frac{R}{M} T_0 \]
\[ u^2 = \frac{\int_S (x^2 + y^2 + z^2 - 2x\cos\alpha) \, dr \, dp \, d\phi}{\frac{\pi}{2} a^2 b^2} \]

\[
2 \pi \frac{2 + \frac{b}{2}}{4} - \frac{\pi}{2} \]

\[
x^2 + \frac{a^2 + b^2}{2} = x^2 + \frac{a^2 + b^2}{2}
\]

\[
a = 2.3 \quad \frac{a^2 + b^2}{2} = 6.84 \quad \frac{2.94}{2.54} \quad \frac{5.48}{2.54} \quad \frac{5.29}{8.34} \quad \frac{13.68}{6.84}
\]

\[
\begin{array}{l}
2.94 \quad 3.94 \\
5.48 \quad 6.07 \\
8.02 \quad 8.43
\end{array}
\]

\[
\begin{array}{l}
2.94 \quad 3.00 \quad 6.42 \\
5.48 \quad 6.84 \quad 6.84
\end{array}
\]

\[
15.49 \quad 36.84 \quad 71.04
\]

\[ 800 \times 4 = 9.8 \]

\[ \frac{36.82}{900} \]

\[ \frac{8800}{900} \]

\[ = 9.8 \]

\[ 800 \times 4 = 9.8 \]
\[
\pi = \frac{2.72.2^2}{4} \left( \frac{1}{71.6^2} - \frac{1}{82.7^2} \right) \\
1.85 \times 10^4 \left( 1.95 - 1.46 \right) \times 10^{-4} = .91
\]

\[
e^{-0.91} = 0.0000
\]

\[
\frac{2\pi}{n} = \frac{314}{44} = 7.18
\]

\[
\frac{d^2}{t^2} = \frac{d^2}{q^2} + \frac{d^2}{t^2} = \frac{62^2}{9} + \frac{62^2}{6}
\]

\[
\frac{1}{R} = W - B
\]

\[
v_0^2 - v_0^2 = 62^2 \left( 1 - \frac{1}{R} \right)
\]

\[
\frac{R}{R - 1} = \frac{52}{6}
\]
\[ 4 \times 10^{17} \times 80 \times 10^{-24} \times \frac{\alpha}{E} \leq \frac{1}{10^{10}} \times 10 \times 2 \times 10^{19} \]

\[ \frac{\alpha}{E} \leq 3 \times 10^{-14} \]

\[ t > 3 \times 10^{13} \text{ sec} \]

\[ \frac{320 \times 10^{8}}{10^{14} \alpha} \frac{3 \times 10^{13}}{10^{13}} \frac{3 \times 10^{13}}{3 \times 10^{7}} \]

\[ \text{effect} < 1\% \text{ means } t > 10^6 \text{ yrs} \]

\[ \frac{1}{\omega} = \frac{R-1}{R} \]

\[ \frac{R-1}{R} \]

\[ \frac{R}{R-1} \]
March 5 44

\[ 110 = R \]
\[ H = 220 \]
\[ \frac{\pi^2}{220^2} + \frac{5.78}{110^2} = (204 + 478) \times 10^{-6} = 682 \times 10^{-6} \]

\[ 57.7 \]
\[ \frac{5.78}{57.7^2} = 1734 \times 10^{-6} \]
\[ 23.9 \]
\[ 30.9 \]

\[ 1.5 \times 10^4 \]

\[ \frac{80}{23.9} \]
\[ \frac{80}{30.9} \]

\[ 28.4 \]
\[ 13.2 \]

\[ 5 \frac{1}{8} \]
\[ \frac{11.8}{1.1} \]
\[ 5 \frac{3}{8} \]

\[ \sqrt{5.125} = 7.7 \text{ cm} \]
\[ 5.5 \]

\[ a = 1.4 \text{ cm} \]
\[ b = 8 \text{ cm} \]

\[ p = 0.912 \]
\[ f = 0.979 \]

\[ 2.4 \sqrt{\frac{8}{3} \times 3500} = 8 \]

\[ 2.4 \sqrt{14 \times 4} = 5 \]

\[ 3500 \]

\[ 10613 \]

\[ 613 \times \frac{4}{11.8} = 208 \]

\[ 14 \text{ cm} \]

\[ 3500 \]
\[
\frac{5.78 \times 10^3}{3.33} = 1734
\]
\[
b_0 = 24.0, 30.8
\]
\[
\frac{1734}{682} = 2.4 \sqrt{\frac{N}{3}} > 80
\]
\[
N > \frac{6400 \times 3}{2.4^2} = 8000
\]
\[
N > 8000
\]
\[
5.0 < \frac{16}{8000} = 2 \times 10^{-27}
\]
\[
99.8\% \quad \frac{2 \times 6 \times 10^{-27}}{15.2} = 1.2 \times 10^{-27}
\]
\[
\frac{15.2}{0.024} = 6300 = N
\]
\[
\begin{array}{c|c|c}
1734 & 15.2 & \frac{15.2}{0.027} \\
82 & 5.5 & \frac{5.5}{0.006} \\
1816 & 4.2 & \frac{4.2}{0.0015} \\
\end{array}
\]
\[
\frac{l = 2.4 \sqrt{6300}}{3} = 110
\]
\[
\frac{1}{E} = 6.2 \times 10^{-6}
\]
\[ \frac{2N}{N-1} = \frac{4.836}{1.433} = 3.398 = \frac{1}{a} \log_{10} \frac{1+a}{1-a} \]

\[ a = 0.914 \]
\[ \sqrt{3 \times 14.6 \times 6.0} \left( 1 - \frac{a^n}{5 \times 14.6} \right) \]

\[ \frac{16.2 \times .036}{914} = 13.3 \]

\[ 14.6 \times .914 = 13.3 \]

\[ \frac{M^2}{\Lambda} \Delta (v_m) + \frac{(k-1) - 5.78}{R^2} + g = 0 \]

\[ \Delta = -\frac{5.78}{R^2} + \frac{d^2}{dx^2} \]

\[ \frac{280}{\Lambda} \]

\[ \frac{M^2}{\Lambda} (v_m)'' + \left( \frac{k-1 - 5.78 M^2}{R^2} \right) v_m + g = 0 \]

\[ \frac{M^2}{\Lambda} (v_m)'' - \frac{M^2}{\Lambda} \frac{1}{b^2} \frac{1}{v_m} \frac{d v_m}{d t} + g = 0 \]

\[ \frac{M^2}{\Lambda} (v_m)'' = \frac{\Lambda}{3} (v_m)' \]

\[ \frac{\Lambda}{M^2} g \]
\[(\text{in})'' - \frac{\nu_n}{L^2} + \frac{\Lambda}{M^2} = 0\]

\[2 \frac{M^2}{\Lambda} \frac{\nu_m}{b} = \frac{\Lambda \lambda}{3 M^2} \frac{\nu_m \nu x 0 \lambda}{\nu} = \nu - \frac{\Lambda \lambda}{3 M^2} = \frac{\nu}{\nu_0} \]

\[
\frac{2.50}{120} \quad \frac{160}{200}
\]

March 12, 1944

Packing fractions

German data of Feb/44

| \(9.0\) | \(-6.75 \times 10^{-4}\) |
| \(9.1\) | \(-6.75\) |
| \(9.4\) | \(-6.42\) |
| \(14.0\) | \(-3.1\) |
| \(14.3\) | \(-2.49\) |
| \(14.4\) | \(-2.49\) |
| \(23.4\) | \(5.17\) |
| \(23.5\) | \(5.29\) |
| \(23.8\) | \(5.61\) |

\[\boxed{25 = 2.50 + 1 \nu + \alpha}\]

\[5.29 \times 23.5 \times 10^{-4} = 0.1242\]

\[Q = 200 \text{ MeV}\]
\[ \frac{\text{fiss}}{\text{cal}} = 1.395 \times 10^{11} \]

\[ 1 \text{ cal} = 2.61 \times 10^{13} \text{ MeV} \]

\[ \frac{49}{\text{cal}} = 1.27 \times 10^{11} \]

\[ \frac{49}{\text{fiss}} = \frac{1.27}{1.395} = 0.91 \]

\[ 1.09 \times 0.91 = \frac{\nu}{1.32} - 1 - \alpha + 0.98 \times 1.2 (1.09 \nu - 0.9) \]

\[ \eta = 1.32 \]

\[ 1 - \eta = 0.12 \]

\[ 0.886 \nu - \alpha = 1 + 0.992 + 0.011 = 2.003 \]

\[ \nu = 2.26 + 1.13 \alpha \]

\[ f = 0.891 \left( 1 + 6.91 \times 10^{-5} t \right) \]

\[ M^2 = 350 + 2500 \left( 1 + 0.01706 t \right) \left( 0.109 - 0.891 \times 6.91 \times 10^{-5} t \right) \]

\[ = 622.5 + 2500 \times 10^9 = 622.5 + 272.5 \left( 114 \times 10^{-5} t \right) \]

\[ k \frac{\Delta n}{\eta} + k \frac{\Delta p}{p} + k \frac{\Delta f}{f} - (k-1) \frac{\Delta M^2}{M^2} \]

\[ 1.062 \frac{k}{5.2} + 6.91 \]

\[ -5.5 (-2) + 7.3 \delta - 3.1 \]

\[ \text{See data 1/6/44} \]
\[ \int \frac{dE}{E} = f(\text{scatter cross sect}) \]
\[ f = f(\sigma_{sc}) \]
\[ \log f + \log \sigma_{sc} \]

<table>
<thead>
<tr>
<th>( f )</th>
<th>( \sigma_{sc} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.117</td>
<td>1.117</td>
</tr>
<tr>
<td>3.220</td>
<td>3.220</td>
</tr>
</tbody>
</table>

\[ \log \sigma_{sc} = -0.986 + 2.103 \log f \]

\[ \sigma_{sc} = 0.103 \times \left( \int \frac{dE}{E} \right)^{2.103} \]

\[ \int \frac{dE}{E} = 2.95 \sigma_{sc} = 0.47 \]

\[ \frac{8.59 \text{ yr/cm}^2}{12} = 0.715 \]

\[ \frac{8.59 \times 6.022}{2 \times 3.2} = \log \]

\[ 2.32 \]

\[ 3800 \]
Intensity amplitude diffused by single plane

\[ f(nXY \sqrt{\frac{\sigma}{4\pi} \frac{\sin \left(\frac{2\pi x \sin \theta}{\lambda} \right)}{\frac{3\pi x}{\lambda} \sin \theta} \frac{\sin \left(\frac{2\pi d M \cos \theta}{\lambda} \right)}{\frac{3\pi d}{\lambda} \cos \theta}}) \]

\( n = \text{atoms/unit surface of plane} \quad \theta = \text{Bragg angle} \)
\( X, Y = \text{dimensions in plane} \quad M = \text{layers} \)

Average on \( \theta \)

\[ \int \frac{\sin^2 A \theta}{A^2 \theta^2} d\theta = \int \frac{\sin^2 A \theta}{2A^2} \frac{2A^2}{\theta} = \frac{1}{2A^2} \log A \]

Integral on solid angle

\[ \frac{2\pi \sin 2 \theta \times 2}{2 \times 4\pi^2 X^2 \sin^2 \theta} \frac{\sin^2 B M \theta}{B^2 \gamma^2} = \frac{4\pi \sin^2 \theta \times M}{M \lambda} \]

\[ f(nXYM) = n^2 X^2 Y^2 \sigma \frac{\lambda^2}{4\pi} \frac{\log 2\pi X \sin \theta}{2 \times 4\pi^2 X^2 \sin^2 \theta} \frac{8\pi^2 \sin \theta \cos \theta}{2\pi d \cos \theta} \]

\[ \sigma = \text{effective cross section} \quad \sigma_{\text{eff}} = \frac{nX^2 Y^2 \sigma}{4\pi^2} \log \left( \frac{\pi X}{d} \times \text{number} \right) \]
\[
\begin{align*}
6000 & = 4000 \\
15 & \quad 3.40 \\
4 x 10^{10} & \quad 1.42 \\
10 - 10 & \quad 71 \\
2.13 & \\
2.13 \times 3.40 & \quad 2.15 \\
\frac{2}{10 - 10} & = .276 \\
\lambda & = 2.46 \\
\lambda & = .392 \\
\lambda & = 4.26 \\
4/1/44 & = .05 \\
M^2 & = 622 (1 + 50t) \\
f & = .821 \left(1 + 6.91t \right) \\
7.35 & \quad 3.12 \\
-3.12 & \quad 5.57 \\
-2 & \quad 10.65 \\
-5 & \quad 7.35 \\
-5 & \quad 3.30 \\
\frac{\sqrt{A(N+1)}}{2} - \frac{\sqrt{A}}{2} & \\
& = e^{i\alpha A} - e^{-i\alpha A} \\
& = \frac{\sin \alpha A}{\sin \alpha A} \frac{N+1}{2} \\
& = \frac{\sin \alpha A}{\sin \alpha A} \frac{N+1}{2}
\end{align*}
\]
\[
\sum_{\eta n, \mu m} \frac{x}{2 R \sin \Theta} \sin \frac{2 \sin \Theta}{x} \frac{R_{\eta n m}}{R_{\eta n m}} \sin \alpha_{\eta n m} = N + \frac{1}{\alpha} F''(\alpha)
\]
\[
\sum_{\eta n, \mu m} \frac{1}{R_{\eta n m}^3} \sin \alpha_{\eta n m} = F'(\alpha)
\]
\[
F''(\alpha) = \sum_{\eta n, \mu m} \frac{1}{R_{\eta n m}^2} \sin \alpha_{\eta n m}
\]

\[
e^{-i \alpha \cos \Theta} = \frac{1}{2} e^{-i \alpha \cos \Theta} d\cos \Theta = \frac{\delta \sin \alpha}{\alpha} d\alpha
\]

\[
\sum_{\eta n, \mu m} e^{i \alpha (x_{\eta n} - x_{\mu m})} = \left| \sum_{n} e^{i \alpha x_n} \right|^2
\]

\[
x_{\eta n} = A_{\eta n} n_1 + B_{\eta n} n_2 + C_{\eta n} n_3 + D_{\eta n}
\]

\[
\sum_{\eta n_1, \mu n_2, \nu n_3} e^{i \alpha x_{\eta n}} + i \alpha B_{\eta n_2} n_2 + i \alpha C_{\eta n_3} n_3 + D_{\eta n_3}
\]

\[
\left| \sum_{\eta n} e^{i \alpha D_{\eta n}} \left( \sum_{n} e^{i \alpha A_{\eta n} x_{n}} \right) \right|^2
\]
\[ \sum_{q} e^{i \alpha D_{x,q}} \left[ \sin^{2} \frac{\alpha A_{x}}{2} \right] \]

\[ \sin^{2} \frac{\alpha A_{x}}{2} \times - \times \]

\[ \alpha = \frac{2 \sin \theta}{x} \]

\[ \int \frac{\sin^{2} Nx}{\sin x} \, dx = \pi N \]

\[ \int \delta(x) \, dx = \frac{1}{2} \delta(x) \]

\[ \sum_{q} e^{i \alpha D_{x,q}} \left[ S(\alpha A_{x}) \delta(\alpha \frac{B_{x}}{2}) \delta(\alpha \frac{C_{x}}{2} - n \pi) \right] \]

\[ \frac{8}{\alpha^{3}} \sum_{q} e^{i \alpha D_{x,q}} \left[ S(A_{x}) S(B_{x}) S(C_{x} - \frac{2 \pi n}{\alpha}) \right] \]

\[ \frac{1}{\pi B \sin \gamma} \]

\[ \frac{1}{2A} \]

\[ \frac{D}{2B} \]
\[ \frac{1}{\pi B \sin \varphi} = \frac{1}{2A} = \frac{1}{2\pi AB \sin \varphi} \]

\[ \frac{8\pi^3}{\alpha^3} N \left[ \sum_q \frac{1}{2} \delta \left( d - \frac{2\pi n}{\alpha} \right) \right] \]

\[ \frac{4\pi^2}{\alpha^3} N \left[ \sum_q \frac{1}{AB \sin \varphi} \delta \left( d - \frac{2\pi m}{\alpha} \right) \right] \]

\[ \frac{4}{3} \frac{44}{3} \]

\[ e^{\frac{i}{\lambda} x} \] primary

\[ \sqrt{\frac{\alpha}{4\pi}} \frac{1}{\pi^2} e^{\frac{i}{\lambda} r} \text{ scattered} \]

\[ \text{Re} = 2 \sin \frac{\varphi}{2} \]

\[ \frac{1}{2} \sqrt{\frac{\alpha}{4\pi}} \sum \left( \frac{\vec{r}}{\vec{r}_n} \right) e^{i(\vec{p}, \vec{r}_n)} \]

\[ |\vec{p}| = \frac{\pi}{\lambda} \sin \frac{\varphi}{2} = \vec{p} \]

\[ \frac{\vec{r}_0}{\vec{r}_1} \frac{\vec{r}_2}{\vec{r}_3} \]

\[ \frac{1}{2} \sqrt{\frac{\alpha}{4\pi}} e^{i(\vec{p}, \vec{r}_0)} N \]

\[ e^{\frac{i}{\alpha} - 1} \times \ldots \times \ldots \times \sum e^{i(\vec{p}, \vec{r}_0)} \text{ amplitude} \]

\[ \frac{\pi}{4\pi \alpha^2} \left| \sum_q e^{i(\vec{p}, \vec{r}_0)} \right|^2 \frac{\sin^2 \frac{N_i (\vec{p}, \vec{r}_0)}{2}}{\sin^2 \frac{(\vec{p}, \vec{r}_0)}{2}} \times \ldots \times \ldots \text{ intensity} \]
\[ \frac{\sigma}{4\pi} \left( \frac{1}{2} \right)^2 \sin^2 \left( \frac{N_1 P}{2} A_x \right) \sin^2 \frac{P}{2} A_x \]

\[ \frac{\sin^2 N x a}{\sin x a} = \pi N \sum_{s=-\infty}^{\infty} S(x - \frac{\pi s}{a}) = \pi N \sum_{s=-\infty}^{\infty} S(x - \frac{\pi s}{a}) \]

\[ \frac{\sigma}{4\pi} \sum_{q} \left| q \right|^3 \frac{N_1 N_2 N_3}{p^3} \sin \frac{A_x - 2\pi s_1}{p} \sin \frac{B_x - 2\pi s_2}{p} \sin \frac{C_x - 2\pi s_3}{p} \]

\[ \frac{2}{\lambda} \sin \frac{\lambda}{2} \frac{\alpha}{\lambda} \frac{4\pi}{\lambda} \sin \frac{\theta}{2} \]

\[ \sin \frac{A_x}{2} \sin \frac{B_x}{2} \sin \frac{C_x}{2} \]

\[ a_2 = a_3 = a \quad A_x = d \]

\[ S(B_x) S(C_x) = \frac{2}{2\pi c \sin \gamma} \times \frac{2\pi B}{4\pi B^2} = \frac{1}{2\pi B C \sin \gamma} \]

Diagram:

- Three vectors labeled B, C, and L.
April 5 44

\[ S(A_x - l_3 l_1) \quad S(B_x - l_3 l_2) \quad S(C_x - l_3 l_3) \]

\[
\begin{align*}
A_x &= l_3 l_1 \\
B_x &= l_3 l_2 \\
C_x &= l_3 l_3
\end{align*}
\]

\[
\begin{align*}
\frac{1}{2} A_x - \frac{1}{2} B_x &= 0 \\
\frac{1}{2} A_x - \frac{1}{2} C_x &= 0 \\
A_x &= l_3 l_1 \\
\gamma &\neq 0
\end{align*}
\]

\[
A' = A
\]

\[
B' = \frac{1}{2} A - \frac{1}{2} B
\]

\[
C' = \frac{1}{2} A - \frac{1}{2} C
\]

\[
E = \langle A, [B, C] \rangle
\]

\[
\ell = \frac{\lambda}{2 \sin \theta}
\]

\[
\begin{align*}
\sqrt{\frac{6}{5}} &+ \sqrt{\frac{6}{5}} \\
\sqrt{\frac{13}{16}} &+ \sqrt{\frac{13}{16}} \\
\frac{13}{8} x^2 (4A^2 B^2) &- 1
\end{align*}
\]
\[ \eta_1 A + \eta_2 B + \eta_3 C = \eta'_1 A' + \eta'_2 B' + \eta'_3 C' \]

\[ \eta_1 = \eta'_1 + \eta'_2 s_2 + \eta'_3 s_3 \]

\[ \eta_2 = -\eta'_2 s_1 \]

\[ \eta_3 = -\eta'_3 s_1 \]

\[ \eta'_1 = \frac{-\eta_2}{s_1} \]

\[ \eta'_2 = \frac{-\eta_3}{s_1} \]

\[ \eta'_3 = \eta_1 - \frac{s_2}{s_1} \eta_2 - \frac{s_3}{s_1} \eta_3 \]

\[ \sum_{n_1} \sum_{n_2} e^{i 2 \pi \frac{\theta}{\lambda} (\frac{A_2}{s_1} n_2 + \frac{A_3}{s_1} n_3)} \]

\[ \frac{1.8 \times 1.6}{12} = 10 \]

\[ \frac{1.20}{1.6 \times 1.8} = 4.2 \]

\[ \frac{1.57}{1.157} = \frac{1.23 \times 3.40}{\sqrt{1.23^2 + 3.40^2}} \]

\[ \frac{1.157}{1.18} = 3.62^2 \]

\[ \frac{1.20 \times 1.7}{\sqrt{1.7^2 + 1.23^2}} \]
\[
\begin{array}{cccc}
20 & 5.2 & .44 & 8.66 \\
40 & 4.1 & .35 & 4.46 \\
60 & 2.7 & .31 & 2.05 \\
80 & 2.0 & .28 & 2.33 \\
100 & 1.64 & .259 & 1.901 \\
120 & 1.369 & .244 & 1.613 \\
140 & 1.173 & .232 & 1.405 \\
160 & 1.027 & .221 & 1.248 \\
180 & .916 & .213 & 1.129 \\
200 & .822 & .202 & 1.028 \\
220 & .747 & .199 & .946 \\
240 & .685 & .194 & .879 \\
\end{array}
\]

\[
+ 14.66 \times 1.40 \frac{(A-2Z)^2}{A} + .602 \frac{Z^2}{A^{1/3}}
\]

\[
20.52 \frac{(A-2Z)^2}{A} + .602 \frac{Z^2}{A^{1/3}}
\]

\[
164.16 + 1.204 \frac{Z}{A^{1/3}}
\]

\[
41.04
\]

\[
-82.08 \frac{A-2Z}{A} + 1.204 \frac{Z}{A^{1/3}}
\]

\[
82.08 \left( \frac{A}{Z_0} - 2 \right) = 1.204 A^{2/3}
\]
\[
\left( \frac{\partial^2 E}{\partial z^2} \right)_A = \frac{164.16}{A} + \frac{1.204}{A^{1/3}}
\]

April 24, 1944

\[ \delta = \text{ratio } \frac{\text{produced}}{\text{consumed}} \]

\[ f \text{ of } 9 \]

\[ (1-e)(\eta_9 + \eta_8) - 1 - \frac{\eta_9}{\eta_8} - p = (1+e) \delta \]

\[ p \text{ f of } 8 \]

\[ \delta = (1-e)(\eta_9 + p \frac{\eta_8}{1+e}) - 1 - \frac{p}{1+e} \]

\[ \frac{dM}{w} = \delta (1+e) \]

\[ \frac{w}{w} = \frac{1+e}{1+p} (\gamma - 1) = \text{increase of } \gamma \]

\[ \text{after } \]

\[ \text{was developed} \]
10000 m
60 kW/m

60000
1350

13.5
1350

4 or 5 watts/cm²

0 0 0 0 0
0 0 0 0 0
0 0 0 0

100
0.5
500000 m

2m

10000 kW/m³
Volume = \frac{1}{2} \pi R^2 - \frac{\pi R^2}{2} = \frac{R^2}{2} \text{ cylinder radius } R

V = \frac{\sqrt{3}}{4} a^2 - \frac{\pi r^2}{2}

\frac{R}{2} = \frac{\sqrt{3}}{4} a^2 - \frac{\pi r^2}{\pi r} = \frac{\sqrt{3}}{4 \pi} \frac{a^2 - \frac{r}{2}}{2}

a = 1
R = 0.15

\sqrt{\frac{2}{5} \frac{7}{92}} \approx 0.138 \frac{a^2}{R} - \frac{r}{2}

\frac{x}{x} = (1-e)(1+p)x - 1

y \sim (1+p)\left((1-e)x - 1\right)
April 27 1944

C 4 2 P 4 D B C 6 0

3456 2866 6557 3704 86

\[ \frac{\pi}{4} x 22^2 = 3.83 \]

\[ \frac{1.1078 \times 0.6022}{2.71 \times 3.83} = 0.00643 \]

\[ 6.43 \times 10^{-4} \]

\[ 6471 \]

\[ \log 2.324 = 0.41 \]

\[ 802 \]

\[ 653 \]

\[ 643 \times 0.99 \]

\[ 931 \]
May 15 1944

\[ \frac{hc}{K} = 0.548 \left[ \frac{r}{K} \right] \left( \frac{N^3 p^2 g (\Delta t)}{\mu^2} \right)^{1/3} \]

\[ y = \log \frac{hcD}{10 K_f} \]

\[ x = \log \left[ \frac{D^3 p^2 r^3 g \Delta t}{K_f \mu^2} \left( \frac{cp \mu_f}{K_f} \right) \right] \]

\[ \beta = \text{thermal coeff of expansion} \]

\[ = \text{reciprocal temperature} \]

\[ c = 0.01 \text{ mm} \]

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
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<tbody>
<tr>
<td>-4</td>
<td>-.31</td>
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<tr>
<td>-3</td>
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<tr>
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<tr>
<td>-1</td>
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<td>5</td>
<td>.97</td>
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<td>6</td>
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<tr>
<td>7</td>
<td>1.46</td>
</tr>
<tr>
<td>8</td>
<td>1.71</td>
</tr>
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</table>

\[ \beta = \frac{8 + v}{h0} (\text{sq ft}) \text{ deg F} \]

\[ = 50 \pm 100 \]
<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>Y</th>
<th>10</th>
<th>( \delta )</th>
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<td>.022</td>
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<tr>
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<td>3</td>
<td>1.58</td>
<td>36</td>
<td>.017</td>
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<tr>
<td>4</td>
<td>1.66</td>
<td>46</td>
<td>.016</td>
<td></td>
</tr>
</tbody>
</table>
\[ D^3 \times 200 \Delta t \times 3 \]

\[ D^3 \times 6 \times 10^4 \Delta t \]

\[ D^3 \times 10^6 = ? \]

\[ x = 6 + 3 \log_{10} D \]

\[ y = \log_{10} \frac{hD}{10 \cdot .0014} \]

\[ D = \frac{1}{2} \]

\[ \frac{3}{4} \]
May 16 44

Vapors condensing on horizontal tubes

\[
\frac{hD}{K} = 0.725 \left( \frac{D^3 \rho^2 g r^2}{K \mu \Delta t} \right)^{1/4}
\]

- \( h \) = latent heat of condensate
- \( \mu \) = viscosity of condensate
- \( \Delta t \) = vapor wall

\[ \Delta t = \frac{v^2}{g} \]

\[ D = 1, \quad \rho = 1, \quad g = 1000, \quad \eta = 500 \]

\[ K = 0.0014, \quad \mu = 0.01 \]

\[ h = 0.0014 \times 0.725 \sqrt{\frac{50000000000}{14 \times 0.01}} \Delta t^{-1/4} = 4.4 \Delta t^{-1/4} \]

\[ 1.375 \times 317 \]

[25000]
\[ \frac{\partial n}{\partial t} = \frac{\lambda n}{3} \Delta v + \frac{k-1}{\Lambda} \nu n \]

\[ = \nu \left[ \frac{(k-1)}{\Lambda} - \frac{\Lambda}{3} \frac{1}{R^2} \right] \]

\[ \frac{1}{\tau} = \frac{1}{T} \left( k-1 - \frac{\pi^2 M^2}{R^2} \right) \]

\[ = \frac{\pi^2 M^2}{T} \left( \frac{1}{R_c^2} - \frac{1}{R^2} \right) \]

\[ \sigma_R = \frac{1}{T} \]

\[ \frac{M^2}{T} \frac{R^3}{R^3} \]

\[ m \left( \frac{\mu^2 R^3}{T M^2} \right)^2 \]

\[ m \left( \frac{\mu^2 R^3}{T M^2} \right)^2 \sim \frac{M^2 R^3}{M^4 T^2} \]

\[ \frac{M^6}{T^2} \]
\[ P \propto R^2 \cdot \frac{1}{(R/k)^2} = \frac{T}{k} \times 2\pi R \cdot x \]
\[ P = \frac{2T}{R} \quad T = E \Delta \frac{\rho}{R} \]
\[ \ddot{r} = -\frac{P}{\rho \delta} = -\frac{1}{\rho \delta} \frac{2}{R} E \Delta \frac{\rho}{R} \]
\[ \ddot{r} = -\frac{2E}{\rho R^2} \frac{\rho}{R} \]
\[ \dot{v}_o = \frac{\sqrt{2E}}{\rho R^2} \frac{\rho}{R} \]
\[ E = \frac{1}{2} M \cdot \frac{E}{\rho R^2} \frac{\rho}{R} = \frac{ME r_o^2}{\rho R^2} \]
\[ W = \frac{4\pi R^2 T_o^2}{E \Delta} \]
\[ W = \frac{4\pi R^2 \delta}{6} \frac{4 \times 10^{16}}{10^{12}} = \frac{4 \times 4 \times 10^4 \times 5 \times 10^{18}}{8 \times 10^{12}} = 4 \times 10^4 \]

\[ 12000 \times 2660 = 720 + 2660 \]
\[ 37000 \times 2220 + 12320 + 2900 \]
\[ 62000 \times 3720 + 29840 + 1380 \]

Water pipes

\[
\frac{(160 + 1.96 t) V_s^{0.8}}{D^{1.2}} = h
\]

\[ V_s = \text{ft/sec} \quad D = \text{inches} \]

\[ h = \text{BTU/hr (sq ft deg F)} \]
\[
\frac{(160 + 1.96t')V_{\frac{1}{3}}}{D_{\frac{1}{2}}^2} = h'
\]

\[
\left[160 + 1.96\left(\frac{32 + 1.8t}{30.48}\right)\right]\left(\frac{V}{30.48}\right)^{\frac{8}{3}}
\]

\[
\frac{(D/2.54)^2}{160} \times 7240 = h
\]

\[
\frac{1 \text{ cal/sec cm}^3}{3600 \times 30.48^2} = 7240
\]

\[
30.48^{\frac{8}{3}} = 15.4
\]

\[
2.54^2 = 1.209
\]

\[
\frac{1.209 \left(\frac{222.8 + 2.53t}{15.4}\right)V^8}{D^2}
\]

\[
h = \left(2.42 + 3.84t\right)\frac{V^8}{D^2} \times 10^{-5}
\]
May 21, 1944

15'

18'

.015 x 30 = .45
May 27, 1944

Resonance absorption of $\text{U}_238$ in water

\[
\frac{1 - dx}{\sigma_A[H] + \sigma_A[A]} \frac{dx}{1 - dx + dx} \frac{\sigma_{\text{Total}}}{\sigma_A[H] + \sigma_A[A]}
\]

\[
e^{-\int \frac{u}{1+u} \, dx} \quad \frac{\sigma_A[A]}{\sigma_H[H]} = \frac{0.0376}{0.00188} = 20
\]

\[
\sigma_A[A] = 0.0376 \cdot \sigma_A[A] = 0.00188
\]

\[
884.8 \times 10^5 = 20
\]

\[
\frac{40 \times 10^5}{1 + (E - 0.3)^2} \cdot \frac{2.900}{1 + (E - 0.3)^2} \cdot \frac{2.900}{1 + (E - 0.3)^2}
\]

\[
\frac{2.900}{\sqrt{E} \left(1 + \left(\frac{E - 0.3}{0.042}\right)^2\right)}
\]

\[
\sqrt{\frac{E}{\left(1 + \left(\frac{E - 0.3}{0.042}\right)^2\right)}}
\]

\[
\sqrt{\left(1 + \left(\frac{E - 0.3}{0.042}\right)^2\right)}
\]

\[
\sqrt{\left(\text{pf } (1-p) \right) \left(1 + \left(\frac{E - 0.3}{0.042}\right)^2\right)}
\]

\[
\sqrt{\left(\text{pf } + (1-p)\right)}
\]
<table>
<thead>
<tr>
<th>E</th>
<th>1050 x \frac{2900}{\text{Exp mce}}</th>
<th>\frac{5.5}{0.285 x 0.239} x 9 = 5.0</th>
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<td>52.0</td>
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<td>.60</td>
<td>1.227</td>
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</tbody>
</table>
Water empty empty

4.4 P

1.512 m radius

vol water

water
metal
= 1.14

met radius 1.5/2 60" long

vol water
metal
= 1.14

cell side = 3.899

6'

1.512

1.512

3.899
Theoretical side 143.1

May 30 1944

\[ \left( \frac{p_i A_1}{\hbar} \right) = 2 \pi n_i \]

\[ \left( \frac{p_i A_1}{\hbar} \right) = \hbar n_i \]

\[ \left( \frac{p_i A_2}{\hbar} \right) = \hbar n_i \]

\[ \left( \frac{p_i A_3}{\hbar} \right) = \hbar n_i \]

\[ \kappa \left( \left[ A_1, A_2 \right], A_3 \right) = \kappa \left( \left[ A_1, A_2 \right], A_3 \right) = \hbar \left[ A_1, A_2 \right] / \text{volume of cell} = \text{fundamental vector of reciprocal lattice} \]

\[ \frac{\hbar}{p_e} = \lambda \]

\[ \lambda v = \nabla \]

\[ v_e = \frac{\nabla}{\hbar} p_e \]

\[ \frac{p_i^2}{2m} = \frac{p_i^2}{2m} + \hbar v_e \]

\[ p_i^2 = p_i^2 + 2m \nabla p_e \]
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<th>$\omega = 10^2$</th>
<th>$\omega = 5^2$</th>
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<td>$9920.0 - 99.2i$</td>
<td>$9920.0 - 99.5i$</td>
<td>$9920.0 - 99.5i$</td>
<td>$9920.0 - 99.5i$</td>
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<tr>
<td>$-0.2i$</td>
<td>$-0.3i$</td>
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<td>$127.7 (+51^15')$</td>
<td>$77.7$</td>
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<td>$1.1i$</td>
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<td>$9920.0 - 99.6i$</td>
<td>$9920.0 - 99.6i$</td>
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<td>$9920 (-0^0 17')$</td>
<td>$105.1 (-32^0 18')$</td>
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<td>$94.4 (-32^0 11')$</td>
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<td>$9920.0 - 4.96i$</td>
<td>$9920.0 - 4.96i$</td>
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<td>$9920.0 - 1.00i$</td>
<td>$9930 (-5^0)$</td>
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<td>$9920.0 - 0.50i$</td>
<td>$9920.0 - 0.50i$</td>
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<td>$9920.0 - 0.20i$</td>
<td>$9920.0 - 0.20i$</td>
<td>$9952 (-10^0)$</td>
<td>$177.7 (-30^0 35')$</td>
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Zone I
0 - 4   0 - 4
∞  4.22  ∞

Zone II
4 - 10
∞  2.19  1.65

Zone III
10 - ∞  6 -

\[
A = \frac{\sqrt{5}}{\Lambda} - 2.31 \Delta
\]

\[
\frac{T}{A} = 0.073
\]

\[
T = \frac{9}{A - 0.0752 - 2.31 \Delta + 0.0173 + 0.0346}
\]

\[
\beta = 0.2104
\]

\[
q = 0.2225 + A
\]

\[
p = 0.3578
\]

\[
q_1 = 0.0752 + A
\]

\[
\frac{(12 + t)}{\Delta} > \frac{1}{\tan}
\]

\[
A = 0.0985
\]
Zone II

\[ \lambda = \frac{q + \sqrt{q^2 - \rho^2}}{\rho_1} \]

\[ \lambda = \frac{q + \sqrt{q^2 - \rho^2}}{\rho_2} \]

\[ \frac{1}{\lambda_1} = \frac{(q + \alpha)^2 \alpha \lambda_{14} - (q - \alpha)^2 \lambda_{14}}{\rho_1 (\alpha \lambda_{14} + \lambda_{12})} \]

\[ \frac{1}{\lambda_2} = \frac{q^2 - \rho^2 - \rho (\frac{1}{\lambda_1} + \frac{1}{\lambda_2}) + \frac{1}{\rho_1 \rho_2}}{0} = 0 \]

Out condition

\[ A = -0.00613 \]

Zone III

\[ \beta = 1.2104 \]

\[ q = 5.2225 + A \]

\[ \beta = 0.0571 = 3.27^\circ \]

\[ A = -0.02 \]

\[ 1.2104 \]

\[ 0.2025 \]

\[ 19.5 + 15.8 = 35.3^\circ \]

\[ A = -0.1 \]

\[ 0.2104 \]

\[ 0.1225 \]

\[ 0.17 + 11.8 = 9.80^\circ \]

\[ 58.8 + 49.4 = 108.2^\circ \]

\[ A = -0.2 \]

\[ 0.2104 \]

\[ 0.0225 \]

\[ 0.2091 = 11.98^\circ \]

\[ 71.9 + 83.9 = 155.8^\circ \]

\[ A = -0.25 \]

\[ 0.2104 \]

\[ -0.0275 \]

\[ 0.2087 = 11.96^\circ \]

\[ 71.8 + 97.5 = 169.3 \]
\[ A = -0.3 \]
\[ \int_{0.0775}^{0.2104} \]
\[ 0.1956 = 11.21^\circ \]
\[ 67.3 + 113.4 = 180.7 \]
\[ \frac{0.05 \times 7}{11.4} \]
\[ 1.035 \]
\[ 11.4 \]
\[ 67.6 + 112.3 = 179.9 \]

\[ (A = -0.297) \]
\[ \int_{-0.0745}^{0.2104} \]
\[ 0.1967 = 11.27^\circ \]

Zone: 1: 0 - 4 \[ A = 0.0985 \]
Zone: 2: 4 - 10 \[ A = -0.00613 \]
Zone: 3: 10 - \infty \[ A = -0.297 \]

\[ A = \frac{\sqrt{3}}{\Lambda} - 2.31 \Delta \]
\[ A = \frac{\sqrt{3}}{\lambda} - 2.31 \lambda \]

\[ \frac{1}{\lambda} = 0 \]

\[ L = \sqrt{1 + L} \]

\[ 0.985 \quad -0.04264 \quad 0.2055 \]

\[ -0.00612 \quad +0.002654 \quad 0.0815 \]

\[ -0.297 \quad +0.1286 \quad 0.3560 \]

\[ K(x) = J_0(2x) \quad 23.6 \]

\[ H(x) = H_0(i x) \]

\[ J_0(8.22) = 0.8380 \quad -1.055 \quad J_1(8.22) = -0.09252 \]

\[ n \quad n'/n \]

\[ \frac{1}{0.25} \quad \frac{2.47}{0.25} \]

\[ K(0.0515 \lambda) + A H(0.0515 \lambda) \]

\[ A = 1.969 \]

\[ n_i = \frac{0.515}{\lambda} \]

\[ \frac{K(0.515) - 1.969 H_1(0.515)}{K(0.515) + 1.969 H_1(0.515)} = \frac{-0.9131}{-0.196} = 0.416 \]

\[ H(0.356 \lambda) \]

\[ 0.04529 \]

\[ 1.259 \]
\[
\begin{align*}
\frac{1}{A} &= 0.11, \quad \frac{\sqrt{2}}{L} = 0.01731 \\
0 &= -0.03515, \quad 0.1874 \\
4 &= +0.01015, \quad 0.1008 \\
10 &= +0.13606, \quad 0.3690 \\
0 - 4: & J_0(1.1874x) \\
&= \frac{-1.1874 J_1(0.7496)}{J_0(0.7496)} = -0.07567 \\
4 - 10: & K(0.1008x) + 1.163H(0.1008x) \\
&= \frac{0.1008}{1.2706 + 1.163 \times 0.2650} = -0.01322 = 0.0084 \\
10: & -0.369 \times 0.011353 \times 0.010064 = -0.416 \\
\end{align*}
\]
\[ A = -0.02 \]
\[ \frac{0.0315}{2.31} = 0.01499 \]

\[ \begin{array}{l}
0 \\
4 \\
10 \\
8 \\
\end{array}
\begin{array}{ll}
-0.05763 & 0.2400 \\
-0.01234 & 0.1111 \\
0.01181 & 0.3342 \\
\end{array} \]

\[ 4 \left\{ \begin{array}{c}
-0.2468 \\
J_1(0.96) \\
J_0(0.96) \\
-0.7825
\end{array} \right\} = -0.1309 \]

\[ \frac{J_1(A) + A N_1}{J_0(0.444) + A N_0} = \frac{-0.1111}{-0.9512 - A \times 0.5305} \]

\[ A = -0.9021 \]

\[ 10 \left\{ \begin{array}{c}
0.4741 \\
(-0.6894) \\
J_1 - 0.9021 N_1 \\
J_0(1.111) - 0.9021 N_0 \\
.1698 \\
.7741 \\
0.017037 \\
-0.3342
\end{array} \right\} = \frac{-0.1218}{0.5612} = -0.2168 \]

\[ \frac{H_1(3.342)}{H_0(3.342)} = -0.3813 \]

\[ \frac{0.014934}{\cdots} \]
\[
\frac{1}{\Lambda} = -0.015
\]

\[
\begin{array}{ccc}
0.07073 & 0.260 & 1.064 \\
-0.03047 & 0.1745 & 0.698 & 1.396 \\
+0.09524 & 0.3087 & 2.47 & \\
\end{array}
\]

\[
\frac{2.660}{7.364} \frac{4602}{1745} = \frac{3282 - A \times 11058}{8819 - A \times 1932} \]

\[A = -0.5553\]

\[
\frac{1745}{5412} + \frac{.5553 \times .4819}{.5691 - .5553 \times .3360} = \frac{.3067}{.4113}
\]

\[366 - 369 = -0.003\]

\[
10^{.012} \left( \begin{array}{c}
10^{-0.0121} \\
\end{array} \right) = \frac{\sqrt{3}}{\Lambda} = 2.14
\]

\[
L + \left\{ \begin{array}{c}
.0991 \\
-.10585
\end{array} \right\} = \frac{.81}{\Lambda}
\]

\[L = \left\{ \begin{array}{c}
.0991 \\
+.00565
\end{array} \right\} + \frac{.81}{\Lambda}
\]

\[
\frac{.81}{\Lambda} = .0235
\]

\[
L = \left\{ \begin{array}{c}
-0.0756 \\
+.02915
\end{array} \right\} + .275
\]

\[
T_0(1.875) = 1.706
\]

\[
\frac{1.706}{H_0(1.853)} = \frac{.275}{.325}
\]

\[A = 34.5\]

\[
250 \pi \times 19 = 14.923\pi
\]

\[
48.2 = \frac{\pi D^3}{4}
\]
\[ L = -0.9112 \int + \frac{0.81}{\Lambda} \]

\[ 0.02 - 0.7112 + 0.02565 + 0.6956 \]

\[ 0.2669 + \frac{48.06}{1035} + 0.6956 \]

\[ 0.1602 + \frac{6.956}{4335} + 0.748 \]

\[ 0.1822 \]

\[ 0.1822 \]

\[ 0.1281 \]

\[ 0.1251 + \frac{9734}{5561} + 0.45 \]

\[ 0.2850 \]

\[ 0.2850 \]

\[ 0.2145 \]

\[ 0.0095 = \frac{0.81}{\Lambda} \]

\[ \Lambda = \frac{85}{50} \]

\[ 0.2826 = \frac{\sqrt{3}}{\Lambda} \]

\[ \frac{1}{\Lambda} \]

\[ 0.25 + \frac{1}{\Lambda} \]

\[ + \frac{2.190}{\Lambda} + 0.96 \times 1.7 = 6.13 \]
\[Fe\]

\[\begin{array}{c}
2.69 & 360^\circ
\end{array}\]

\[Fe\]

\[\begin{array}{c}
9.2 & 1.3
\end{array}\]

\[\begin{array}{c}
I \\
II
\end{array}\]

\[\begin{array}{c}
1 & 2 \cos 79.2 \\
1 & 2 \cos 158.4 \\
1 & 2 \cos 237.6
\end{array}\]

\[Fe \pm 1.10\]

\[S \pm 0.375\]

\[3.41 \quad 2.59\]

\[1 \quad 12\]

\[1.0 \quad 5.0\]

\[1.9 \quad 4.1\]
\[ B = \frac{16 \pi^2 kT}{f \lambda^2} \]

For restoring force per unit displacement.

For NaCl at room temp: \[ B = 6.4 \mu \text{N/Å} \]

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<th>NaCl (100)</th>
<th>CaF₂ (111)</th>
<th>Fe₃S₄ (100)</th>
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<td>(111)</td>
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<td>11</td>
<td>99.5</td>
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(111) | (111)

100 | 100

147 | 116

11 | 10
\[ u = \frac{3\pi}{8} \]

\[ 12 + 4u(-1)^n + 8 \cos\left(\frac{3\pi n}{8}\right) \]

\[ \frac{3\pi}{8} - \frac{3\pi}{8} = \frac{3\pi}{8} - \frac{3\pi}{8} \]

\[ \pm 0.816 \ 4 \cos\left(66.2^\circ\right) + 12 \cos\left(82.1^\circ\right) \]

\[ 66.2 \ 1.61 + 1.67 \ 82.1 \]

\[ 132.5 \ -2.70 - 1.51 \ 164.1 \]

\[ 198.7 \ -3.79 - 4.88 \ 246.7 \]

\[ 264.8 \ -3.34 + 10.14 \ 328 \]

\[ 331 \ + 3.50 + 7.70 \ 410 \]

\[ 2.35 \text{ Fe} + 1.56 \]

\[ 16 \text{ Fe} - 2.42 \]

\[ 13.65 \text{ Fe} - 17.34 \]

\[ 8 \text{ Fe} + 19.68 \]

\[ 13.65 \text{ Fe} + 22.40 \]
\begin{align*}
\text{Mg} + 2 \, \text{O} \cos \left(90^\circ \right) + 2 \, \text{H} \cos \left(158^\circ \right) \\
\text{Mg} &\rightarrow -1.85 \, \text{H} \\
\text{Mg} &\rightarrow -2.0 \ + 1.44 \, \text{H} \\
\text{Mg} &\rightarrow -0.81 \, \text{H} \\
\text{Mg} &\rightarrow +2.0 \ + 0.66 \, \text{H} \\
\text{Mg} &\rightarrow +1.68 \, \text{H}
\end{align*}

\begin{align*}
\text{Mg} &\rightarrow 4.2 \\
\text{Mg} &\rightarrow -3.7 \\
\text{Mg} &\rightarrow 3.0 \\
\text{Mg} &\rightarrow 5.9 \\
\text{Mg} &\rightarrow 1.2
\end{align*}

\begin{align*}
\text{O} &\rightarrow 2 \\
\text{H} &\rightarrow -0.2 \\
\text{Mg} &\rightarrow 2 \ + 0 \\
\text{H} &\rightarrow -6.2
\end{align*}
$10 \pm 3u \pm 4u \pm 7u \pm 11u$

$100 \pm \frac{1}{2} \pm u \pm \frac{1}{2} \pm u$