

E23 060 P08

1711F

Oblique incidence の場合.

i) $\lim_{\epsilon \rightarrow 0} \dots$ limit $n \rightarrow 1$ の時

from $f = \frac{1}{2}$ の factor が出て

ii) $\lim_{\epsilon \rightarrow 0} \dots$ limit $n \rightarrow 1$ の時

from factor $n \rightarrow 1$ が出て

i) $\delta \rightarrow 0$ の時 $\lim_{\epsilon \rightarrow 0} \dots$ の場合

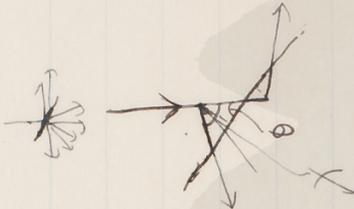
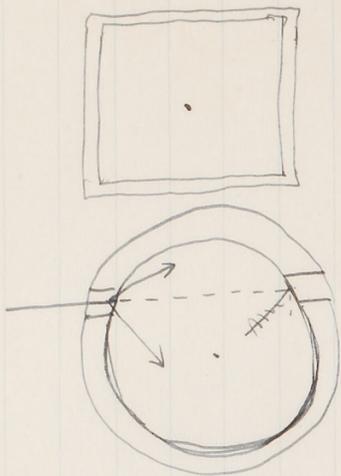
は $\epsilon < \dots$

ii) $\lim_{\epsilon \rightarrow 0} \dots$ limit $n \rightarrow 1$ の時

は \dots

$\therefore f = \frac{1}{2}$ の場合 $n \rightarrow 1$ の場合

は \dots



$x=0.2: \frac{25}{(45.4)^2} \left[1 + \frac{1.2}{10.6} + \frac{4.8}{15.4} - \frac{1.0}{10.8} \right]$
 $\frac{17.6}{15.4}$
 $\frac{15.4}{15.4}$
 $\frac{616}{770}$
 $\frac{154}{237.16}$
 $\frac{237.16}{237.16}$
 $\frac{0.105}{237}$
 $\frac{130}{130}$
 $\frac{1.4}{1.4}$
 $\frac{10.6}{10.6}$
 $x=0.4: \frac{25}{(19.8)^2} \left[1 + \frac{1.4}{8.2} + \frac{5.6}{13.8} - \frac{7.5}{8.2} \right]$
 $\frac{17.6}{8.2}$
 $\frac{13.8}{13.8}$
 $\frac{1104}{414}$
 $\frac{138}{190.44}$
 $\frac{0.193}{198}$
 $\frac{19}{60}$
 $\frac{59}{30}$
 $\frac{8.2}{8.2}$
 $\frac{0.51}{0.51}$
 $\frac{0.0485}{0.0485}$
 $\frac{13}{85}$
 $\frac{65}{65}$
 $\frac{104}{1105}$
 $x=0.6: \frac{25}{(12.2)^2} \left[1 + \frac{1.6}{5.8} + \frac{6.4}{12.2} - \frac{5}{5.8} \right]$
 $\frac{17.6}{12.2}$
 $\frac{5.8}{5.8}$
 $\frac{862}{524}$
 $\frac{0.338}{1.6}$
 $\frac{2028}{538}$
 $\frac{0.5408}{5.8}$
 $\frac{522}{188}$
 $\frac{17.2}{5.8}$
 $\frac{0.093}{0.093}$
 $\frac{0.5408}{5.22}$
 $\frac{122}{122}$
 $\frac{244}{244}$
 $\frac{122}{14884}$
 $\frac{17.6}{17.6}$
 $\frac{5-2.4}{9.6}$
 $\frac{13.4}{34}$
 $x=0.8: \frac{25}{(10.6)^2} \left[1 + \frac{1.8}{6.2} + \frac{1.8}{3.4} - \frac{2.5}{10.6} \right]$
 $\frac{17.6}{10.6}$
 $\frac{10.6}{10.6}$
 $\frac{0.218}{0.218}$
 $\frac{2425}{224}$
 $\frac{106656}{112}$
 $\frac{0.974}{4870}$
 $\frac{1948}{24350}$
 $\frac{112}{112}$
 $\frac{185}{978}$
 $\frac{1.8}{1.8}$
 $\frac{3.4}{3.4}$
 $\frac{0.974}{4.67}$
 $\frac{2.5}{2.5}$
 $\frac{10.6}{10.6}$
 $\frac{1.67}{1.67}$
 $\frac{0.515}{0.515}$
 $\frac{41.7}{405}$
 $\frac{120}{120}$
 $x=1: \frac{25}{81} \left[1 + \frac{2}{1} + \frac{1.7}{1.7} - \frac{2.5}{5} \right]$
 $\frac{1.7}{1.7}$
 $\frac{2.5}{2.5}$
 $\frac{1.7}{1.7}$
 $\frac{0.05}{0.05}$
 $\frac{1.7}{1.7}$
 $\frac{0.091}{0.091}$
 $\frac{0.13856}{0.13856}$
 $\frac{0.4}{0.4}$
 $\frac{0.17}{0.17}$
 $\frac{149.25}{149.25}$
 $\frac{1067.2}{1010}$
 $\frac{0.68}{0.68}$
 $\frac{6.36}{6.36}$
 $\frac{0.73840}{0.73840}$
 $\frac{0.05}{0.05}$
 $\frac{1.7}{1.7}$
 $\frac{0.091}{0.091}$
 $\frac{0.026}{0.026}$
 $\frac{0.41}{0.41}$
 $\frac{0.974}{0.974}$
 $\frac{1.67}{1.67}$
 $\frac{2.5}{2.5}$
 $\frac{5}{5}$

$\zeta=1.05$ $\zeta^2=1.1025$
 15.21634
 $- 5.27266$

 9.94368
 1.103

 29829
 9943

 10.967129
 0.00857

 11.9670125
 9588

 6820
 5980

 8400

$\zeta=1.2$ $\zeta^2=1.44$
 $(\zeta-1)(\zeta+1)=0.088$
 $\log 0.088 = 2.17475 - 2 \times 2.30259$
 4.60578
 2.17475

 2.43043

$8 \times \log 10 - \log 4.688$
 1.54116

$\zeta=1.5$ $\zeta^2=2.25$
 $(\zeta-1)(\zeta+1) = 0.5 \times 1.25 = 0.625$
 $\log 0.625 = 1.83258 - 2.30259$
 1.83258

 0.47001

15.21634
 0.47001

 14.74633
 2.25

 73730
 29492

 33.17850

$\zeta=2$ $\zeta^2=4$ $(\zeta-1)(\zeta+1)=3$
 $\log 3 = 1.09861$
 15.21634

 16.31495
 4

 65.260

$\zeta=4$ $\zeta^2=16$ $(\zeta-1)(\zeta+1)=45$
 $\log 45 = 3.80667$
 15.21634

 19.0230
 16

 14.158
 19.023

 30.4368

$\zeta=3$ $\zeta^2=9$ $(\zeta-1)(\zeta+1)=16$
 $\log 16 = 2.7726$
 15.21634

 17.9889
 163

 0.0490
 163

 8.052
 1480

 1467
 130

$\zeta=1.1025$ $\zeta^2=1.44$
 15.21634
 $- 2.43043$

 12.78591
 1.144

 51144
 51144

 12786
 18.41184

19.41 0.4400
 3882

 5180
 3882

 12980
 1164

 13340

2.30259
 13.81554

 15.4116
 12.27338

 13.24
 2.706

 432
 4.6684

$\zeta^2 \log a + \log(\zeta-1)$
 $+ \log(\zeta+1) + 1$
 $\zeta^2 - 1$

$(\zeta-1) \{ 2 \zeta (\log a + \log(\zeta-1)) + \log(\zeta^2-1) \}$
 $+ \zeta \left(\frac{1}{\zeta-1} + \frac{2\zeta}{\zeta+1} \right) - 2\zeta$
 $\zeta^2 \log a (\zeta-1)(\zeta+1)$
 $= \frac{1}{\zeta-1} - \frac{\zeta}{2} \left(\frac{1}{\zeta-1} + \frac{2\zeta}{\zeta+1} \right)$
 $= \frac{2 - \zeta(\zeta+1) - 2\zeta^2}{2(\zeta-1)} = \frac{2 - \zeta - 3\zeta^2}{2(\zeta-1)}$
 $- 2\zeta \log + \zeta \left(\frac{\zeta^2 + \zeta + 2\zeta^2 - 2}{\zeta(\zeta-1)} \right) \log$
 $\log(\) = \frac{3\zeta^2 - 1}{2} = \frac{3\zeta^2 + \zeta - 2}{1\zeta^2}$

$\gamma=0 \quad d\phi = \frac{1}{2} + \frac{x}{2}$

$\gamma=4 \quad d\phi = \frac{25}{(17-8x)^2} \left[1 + \frac{(1+x)}{13-12x} \right] + \frac{(1+x)}{17-8x} - \frac{16}{25(1-x)} \left. \vphantom{\frac{25}{(17-8x)^2}} \right\}$

$x=-1: \quad \frac{25}{(25)^2} \left[1 - \frac{25}{25} \right] = 0.04$

$x=-0.8: \quad \frac{25}{(23.4)^2} \left[1 + \frac{0.2}{22.6} \right] - \frac{0.2}{22.6}$

$x=0.4: \quad \frac{25}{(20.2)^2} \left[1 + \frac{1.6}{21.8} \right] - \frac{1.6}{21.8}$

$x=0.6: \quad \frac{25}{(21.8)^2} \left[1 + \frac{0.4}{20.2} \right] - \frac{0.4}{20.2}$

$x=0.8: \quad \frac{25}{(25)^2} \left[1 + \frac{0.8}{25} \right] - \frac{0.8}{25}$

$x=1.0: \quad \frac{25}{(30)^2} \left[1 + \frac{1.0}{30} \right] - \frac{1.0}{30}$

$x=1.2: \quad \frac{25}{(36)^2} \left[1 + \frac{1.2}{36} \right] - \frac{1.2}{36}$

$x=1.4: \quad \frac{25}{(42)^2} \left[1 + \frac{1.4}{42} \right] - \frac{1.4}{42}$

$x=1.6: \quad \frac{25}{(48)^2} \left[1 + \frac{1.6}{48} \right] - \frac{1.6}{48}$

$x=1.8: \quad \frac{25}{(54)^2} \left[1 + \frac{1.8}{54} \right] - \frac{1.8}{54}$

$x=2.0: \quad \frac{25}{(60)^2} \left[1 + \frac{2.0}{60} \right] - \frac{2.0}{60}$

$x=2.2: \quad \frac{25}{(66)^2} \left[1 + \frac{2.2}{66} \right] - \frac{2.2}{66}$

$x=2.4: \quad \frac{25}{(72)^2} \left[1 + \frac{2.4}{72} \right] - \frac{2.4}{72}$

$x=2.6: \quad \frac{25}{(78)^2} \left[1 + \frac{2.6}{78} \right] - \frac{2.6}{78}$

$x=2.8: \quad \frac{25}{(84)^2} \left[1 + \frac{2.8}{84} \right] - \frac{2.8}{84}$

$x=3.0: \quad \frac{25}{(90)^2} \left[1 + \frac{3.0}{90} \right] - \frac{3.0}{90}$

$x=3.2: \quad \frac{25}{(96)^2} \left[1 + \frac{3.2}{96} \right] - \frac{3.2}{96}$

$x=3.4: \quad \frac{25}{(102)^2} \left[1 + \frac{3.4}{102} \right] - \frac{3.4}{102}$

$x=3.6: \quad \frac{25}{(108)^2} \left[1 + \frac{3.6}{108} \right] - \frac{3.6}{108}$

$x=3.8: \quad \frac{25}{(114)^2} \left[1 + \frac{3.8}{114} \right] - \frac{3.8}{114}$

$x=4.0: \quad \frac{25}{(120)^2} \left[1 + \frac{4.0}{120} \right] - \frac{4.0}{120}$

$x=0: \quad \frac{25}{(17)^2} \left[1 + \frac{1}{13} \right] - \frac{1}{13}$

$x=0.2: \quad \frac{25}{(18.6)^2} \left[1 + \frac{0.2}{18.6} \right] - \frac{0.2}{18.6}$

$x=0.4: \quad \frac{25}{(20.2)^2} \left[1 + \frac{0.4}{20.2} \right] - \frac{0.4}{20.2}$

$x=0.6: \quad \frac{25}{(21.8)^2} \left[1 + \frac{0.6}{21.8} \right] - \frac{0.6}{21.8}$

$x=0.8: \quad \frac{25}{(23.4)^2} \left[1 + \frac{0.8}{23.4} \right] - \frac{0.8}{23.4}$

$x=1.0: \quad \frac{25}{(25)^2} \left[1 + \frac{1.0}{25} \right] - \frac{1.0}{25}$

$x=1.2: \quad \frac{25}{(26.6)^2} \left[1 + \frac{1.2}{26.6} \right] - \frac{1.2}{26.6}$

$x=1.4: \quad \frac{25}{(28.2)^2} \left[1 + \frac{1.4}{28.2} \right] - \frac{1.4}{28.2}$

$x=1.6: \quad \frac{25}{(29.8)^2} \left[1 + \frac{1.6}{29.8} \right] - \frac{1.6}{29.8}$

$x=1.8: \quad \frac{25}{(31.4)^2} \left[1 + \frac{1.8}{31.4} \right] - \frac{1.8}{31.4}$

$x=2.0: \quad \frac{25}{(33)^2} \left[1 + \frac{2.0}{33} \right] - \frac{2.0}{33}$

$x=2.2: \quad \frac{25}{(34.6)^2} \left[1 + \frac{2.2}{34.6} \right] - \frac{2.2}{34.6}$

$x=2.4: \quad \frac{25}{(36.2)^2} \left[1 + \frac{2.4}{36.2} \right] - \frac{2.4}{36.2}$

$x=2.6: \quad \frac{25}{(37.8)^2} \left[1 + \frac{2.6}{37.8} \right] - \frac{2.6}{37.8}$

$x=2.8: \quad \frac{25}{(39.4)^2} \left[1 + \frac{2.8}{39.4} \right] - \frac{2.8}{39.4}$

$x=3.0: \quad \frac{25}{(41)^2} \left[1 + \frac{3.0}{41} \right] - \frac{3.0}{41}$

$x=3.2: \quad \frac{25}{(42.6)^2} \left[1 + \frac{3.2}{42.6} \right] - \frac{3.2}{42.6}$

$x=3.4: \quad \frac{25}{(44.2)^2} \left[1 + \frac{3.4}{44.2} \right] - \frac{3.4}{44.2}$

$x=3.6: \quad \frac{25}{(45.8)^2} \left[1 + \frac{3.6}{45.8} \right] - \frac{3.6}{45.8}$

$x=3.8: \quad \frac{25}{(47.4)^2} \left[1 + \frac{3.8}{47.4} \right] - \frac{3.8}{47.4}$

$x=4.0: \quad \frac{25}{(49)^2} \left[1 + \frac{4.0}{49} \right] - \frac{4.0}{49}$

$$x = 1: \frac{16}{36} \cdot \left[1 + \frac{4}{2} \cdot \frac{0.666}{1.646} \cdot \frac{2.033}{4.393} \right]$$

$$x = 1: d\phi = r^2 \sin \theta d\theta d\phi \cdot \frac{16}{(1-x)^2} \left[1 + \frac{2(1+x)}{5-3x} \left\{ \frac{1+x}{1-x} - \frac{4(1-x)}{5-3x} \right\} \right]$$

$$x = -1: \frac{16}{64} \left[1 + \frac{4}{2} \cdot \frac{0.666}{1.646} \cdot \frac{2.033}{4.393} \right] = 0.25$$

$$x = -0.8: \frac{16}{(1.8)^2} \left[1 + \frac{0.4}{7.4} \left\{ \frac{1.2}{1.8} - \frac{4 \times 1.8}{7.4} \right\} \right] = 0.40 \underline{0.25}$$

$$x = -0.6: \frac{16}{(1.6)^2} \left[1 + \frac{0.8}{6.8} \left\{ \frac{1.4}{1.6} - \frac{4 \times 1.6}{6.8} \right\} \right] = 0.25$$

$$x = -0.4: \frac{16}{(1.4)^2} \left[1 + \frac{1.2}{6.2} \left\{ \frac{1.6}{1.4} - \frac{4 \times 1.4}{6.2} \right\} \right] = 0.25$$

Calculations for $x = -0.8$:

$$\frac{16}{3.24} \left[1 + \frac{0.4}{7.4} \left\{ \frac{1.2}{1.8} - \frac{7.2}{7.4} \right\} \right]$$

$$= 4.938 \left[1 + \frac{0.4}{7.4} \left\{ \frac{1.2}{1.8} - \frac{7.2}{7.4} \right\} \right]$$

$$= 4.938 \left[1 + \frac{0.4}{7.4} \left\{ \frac{1.2}{1.8} - \frac{7.2}{7.4} \right\} \right]$$

$$= 4.938 \left[1 + \frac{0.4}{7.4} \left\{ \frac{1.2}{1.8} - \frac{7.2}{7.4} \right\} \right]$$

Calculations for $x = -0.6$:

$$\frac{16}{2.56} \left[1 + \frac{0.8}{6.8} \left\{ \frac{1.4}{1.6} - \frac{6.4}{6.8} \right\} \right]$$

$$= 6.25 \left[1 + \frac{0.8}{6.8} \left\{ \frac{1.4}{1.6} - \frac{6.4}{6.8} \right\} \right]$$

$$= 6.25 \left[1 + \frac{0.8}{6.8} \left\{ \frac{1.4}{1.6} - \frac{6.4}{6.8} \right\} \right]$$

$$= 6.25 \left[1 + \frac{0.8}{6.8} \left\{ \frac{1.4}{1.6} - \frac{6.4}{6.8} \right\} \right]$$

Calculations for $x = -0.4$:

$$\frac{16}{1.96} \left[1 + \frac{1.2}{6.2} \left\{ \frac{1.6}{1.4} - \frac{5.6}{6.2} \right\} \right]$$

$$= 8.163 \left[1 + \frac{1.2}{6.2} \left\{ \frac{1.6}{1.4} - \frac{5.6}{6.2} \right\} \right]$$

$$= 8.163 \left[1 + \frac{1.2}{6.2} \left\{ \frac{1.6}{1.4} - \frac{5.6}{6.2} \right\} \right]$$

$$= 8.163 \left[1 + \frac{1.2}{6.2} \left\{ \frac{1.6}{1.4} - \frac{5.6}{6.2} \right\} \right]$$

$$x = -0.2: \quad \frac{16}{(1.2)^2} \left[1 + \frac{1.6}{5.6} - \frac{0.8}{1.2} - \frac{3.48}{5.6} \right] = 0.24$$

$$\begin{array}{r} 0.856 \\ 7 \overline{) 6} \\ \underline{56} \\ 40 \end{array}$$

$$\begin{array}{r} 0.213 \\ 7 \overline{) 1.49} \\ \underline{149} \\ 0 \end{array}$$

$$\begin{array}{r} 0.23 \\ 3 \overline{) 0.78} \\ \underline{6} \\ 18 \\ \underline{18} \\ 0 \end{array}$$

$$\begin{array}{r} 0.243 \\ 3 \overline{) 0.787} \\ \underline{6} \\ 187 \\ \underline{180} \\ 70 \\ \underline{648} \\ 50 \end{array}$$

$$\begin{array}{r} 1.8 \\ 1.8 \\ \underline{144} \\ 18 \\ \underline{18} \\ 0 \end{array}$$

$$\begin{array}{r} 3.24 \\ 18 \\ \underline{18} \\ 0 \end{array}$$

$$x = 0: \quad \frac{16}{49} \left[1 + \frac{2}{5} - \frac{1}{7} - \frac{4}{5} \right] = 0.24$$

$$\begin{array}{r} 0.8 \\ 0.14 \\ \underline{0.66} \\ 0.26 \\ 5 \overline{) 1.32} \\ \underline{10} \\ 32 \\ \underline{30} \\ 2 \end{array}$$

$$\begin{array}{r} 0.14 \\ 7 \overline{) 1} \\ \underline{70} \\ 30 \end{array}$$

$$\begin{array}{r} 0.24 \\ 49 \overline{) 12.84} \\ \underline{98} \\ 304 \\ \underline{294} \\ 104 \\ \underline{98} \\ 64 \end{array}$$

$$x = 0.2: \quad \frac{16}{(0.8)^2} \left[1 + \frac{2.4}{4.4} - \frac{0.2}{0.8} - \frac{3.2}{4.4} \right] = 0.24$$

$$\begin{array}{r} 0.73 \\ 61 \overline{) 44.8} \\ \underline{427} \\ 21 \end{array}$$

$$\begin{array}{r} 0.7 \\ 39 \\ \underline{39} \\ 0 \end{array}$$

$$\begin{array}{r} 0.078 \\ 61 \overline{) 4.8} \\ \underline{427} \\ 53 \end{array}$$

$$\begin{array}{r} 0.55 \\ 0.6 \\ \underline{0.45} \\ 0.15 \end{array}$$

$$\begin{array}{r} 0.3 \\ 0.7 \\ \underline{0.43} \\ 0.27 \end{array}$$

$$\begin{array}{r} 1.7 \\ 1.7 \\ \underline{1.7} \\ 0 \end{array}$$

$$\begin{array}{r} 1.17 \\ 1.17 \\ \underline{1.17} \\ 0 \end{array}$$

$$\begin{array}{r} 0.242 \\ 2.89 \overline{) 0.750} \\ \underline{578} \\ 1720 \\ \underline{1756} \\ 640 \end{array}$$

$$x=0.4: \frac{4}{\frac{76}{(6.6)^2} \left[1 + \frac{1.4}{2.8} \left\{ \frac{1.7}{\frac{1.4}{3.18}} - \frac{2.4}{\frac{3.8}{1.9}} \right\} \right] = 0.25}$$

$$19) \overline{) 12} \begin{array}{r} 0.63 \\ 114 \\ \hline 60 \\ 59 \end{array}$$

$$23) \overline{) 6.7} \begin{array}{r} 0.21 \\ 66 \\ \hline 48 \\ 39 \\ \hline 70 \end{array}$$

$$\frac{0.42}{1.4} = \frac{0.31}{1.9} \Rightarrow \frac{42}{14} = \frac{31}{19} \Rightarrow \frac{42 \cdot 19}{14 \cdot 19} = \frac{31 \cdot 14}{19 \cdot 14} \Rightarrow \frac{798}{266} = \frac{434}{266}$$

$$\frac{0.69}{2.76} = \frac{9}{36} = \frac{1}{4}$$

$$\frac{33}{99} = \frac{0.25}{1.0} \Rightarrow \frac{33}{99} = \frac{25}{100} \Rightarrow \frac{33 \cdot 100}{99 \cdot 100} = \frac{25 \cdot 99}{99 \cdot 100} \Rightarrow \frac{3300}{9900} = \frac{2475}{9900}$$

$$x=0.74: \frac{4}{\frac{76}{(6.6)^2} \left[1 + \frac{4.2}{2.8} \left\{ \frac{2}{2.8} \right\} \right]} = 0.74$$

$$\frac{1.6}{6.6} = \frac{4}{36} \Rightarrow \frac{1.6 \cdot 36}{6.6 \cdot 36} = \frac{4 \cdot 6.6}{6.6 \cdot 36} \Rightarrow \frac{57.6}{237.6} = \frac{26.4}{237.6}$$

$$x=0.6: \frac{76}{(6.4)^2} \left[1 + \frac{3.2}{3.2} \left\{ \frac{1.6}{6.44} - \frac{1.6}{3.2} \right\} \right] = 0.29$$

$$\frac{0.25}{3.0} = \frac{1.6}{2.56} \Rightarrow \frac{25}{300} = \frac{16}{256} \Rightarrow \frac{25 \cdot 256}{300 \cdot 256} = \frac{16 \cdot 300}{300 \cdot 256} \Rightarrow \frac{6400}{76800} = \frac{4800}{76800}$$

$$x=0.8: \frac{76}{(6.2)^2} \left[1 + \frac{1.8}{3.6} \left\{ \frac{0.9}{\frac{1.8}{2.16}} - \frac{0.8}{\frac{2.16}{1.3}} \right\} \right] = 0.40$$

$$\frac{0.2}{1.8} = \frac{0.036}{2.6} \Rightarrow \frac{20}{180} = \frac{36}{260} \Rightarrow \frac{20 \cdot 260}{180 \cdot 260} = \frac{36 \cdot 180}{180 \cdot 260} \Rightarrow \frac{5200}{46800} = \frac{6480}{46800}$$

$$\frac{3.1}{2.1} = \frac{3.1}{9.61} \Rightarrow \frac{3.1 \cdot 9.61}{2.1 \cdot 9.61} = \frac{3.1 \cdot 2.1}{2.1 \cdot 9.61} \Rightarrow \frac{29.91}{20.181} = \frac{6.51}{20.181}$$

$\chi = |x|$

	-0.8	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
$\frac{d\phi}{r_0^2 d\phi dx}$	0.25	0.25	0.25	0.25	0.24	0.24	0.25	0.29	0.40
$\frac{2\pi}{E}$	1.05	1.16	1.22	1.29	1.35	1.42	1.5	1.58	1.66
baseV	25000	53500	81600	110000	148000	198000	255000	296000	340000
baseV/m	0.0013	0.005	0.009	0.015	0.023	0.035	0.045	0.06	0.08
$\cos X = \frac{1+x}{2}$	0.316	0.472	0.548	0.632	0.715	0.775	0.837	0.894	1.00
$\sin X \cos X$	0.0004	0.004	0.0049	0.0095	0.016	0.029	0.038	0.054	0.076

$\int \left(\frac{d\phi}{r_0^2 d\phi dx} \right) \cdot R.P. \cdot \left(\frac{1+x}{2} \right)^{\frac{1}{2}} dx \approx 0.21$

0.1

$E = \frac{(p+1)^2 + 0 - \frac{1+x}{2}}{(p+1)^2 - \gamma - \frac{1+x}{2}}$

$\gamma = 1 = \frac{4 + \frac{1+x}{2}}{4 - \frac{1+x}{2}}$

3.9) $\frac{4.1}{3.9} = \frac{200}{39}$

3.8) $\frac{4.2}{3.8} = \frac{1105}{195}$

3.7) $\frac{4.3}{3.7} = \frac{118}{37}$

3.6) $\frac{4.4}{3.6} = \frac{12}{3.6}$

3.5) $\frac{4.5}{3.5} = \frac{142}{35}$

3.4) $\frac{4.6}{3.4} = \frac{138}{34}$

3.3) $\frac{4.7}{3.3} = \frac{140}{33}$

3.2) $\frac{4.8}{3.2} = \frac{142}{32}$

3.1) $\frac{4.9}{3.1} = \frac{149}{31}$

3.0) $\frac{5.0}{3.0} = \frac{150}{30}$

2.9) $\frac{5.1}{2.9} = \frac{155}{29}$

2.8) $\frac{5.2}{2.8} = \frac{160}{28}$

2.7) $\frac{5.3}{2.7} = \frac{166}{27}$

2.6) $\frac{5.4}{2.6} = \frac{175}{26}$

2.5) $\frac{5.5}{2.5} = \frac{180}{25}$

2.4) $\frac{5.6}{2.4} = \frac{188}{24}$

2.3) $\frac{5.7}{2.3} = \frac{197}{23}$

2.2) $\frac{5.8}{2.2} = \frac{207}{22}$

2.1) $\frac{5.9}{2.1} = \frac{218}{21}$

2.0) $\frac{6.0}{2.0} = \frac{230}{20}$

1.9) $\frac{6.1}{1.9} = \frac{242}{19}$

1.8) $\frac{6.2}{1.8} = \frac{255}{18}$

1.7) $\frac{6.3}{1.7} = \frac{268}{17}$

1.6) $\frac{6.4}{1.6} = \frac{282}{16}$

1.5) $\frac{6.5}{1.5} = \frac{297}{15}$

1.4) $\frac{6.6}{1.4} = \frac{312}{14}$

1.3) $\frac{6.7}{1.3} = \frac{328}{13}$

1.2) $\frac{6.8}{1.2} = \frac{345}{12}$

1.1) $\frac{6.9}{1.1} = \frac{363}{11}$

1.0) $\frac{7.0}{1.0} = \frac{382}{10}$

0.9) $\frac{7.1}{0.9} = \frac{392}{9}$

0.8) $\frac{7.2}{0.8} = \frac{403}{8}$

0.7) $\frac{7.3}{0.7} = \frac{415}{7}$

0.6) $\frac{7.4}{0.6} = \frac{428}{6}$

0.5) $\frac{7.5}{0.5} = \frac{442}{5}$

0.4) $\frac{7.6}{0.4} = \frac{457}{4}$

0.3) $\frac{7.7}{0.3} = \frac{473}{3}$

0.2) $\frac{7.8}{0.2} = \frac{489}{2}$

0.1) $\frac{7.9}{0.1} = \frac{506}{1}$

1.4

0.010032
 0.004550
 0.002484
 0.00396
 0.02103

~~0.09~~ 0.03
~~0.088~~ 0.007
~~72~~ 0.0091
~~0.00792~~ 0.092
~~0.01584~~ 0.005

0.176 0.130 0.092
~~0.057~~ 0.35 0.27
 1132 644
 886 39 184
 0.10032 0.04550 0.02484

0.16
 0.021
 32
 0.00336

0.1
 x0.25
 0.038
 0.054
 0.032
 0.019
 0.0048
 0.0048
 0.0008
 4)0.01584
 0.00396

$$r=1. \int \frac{d\phi}{(r_0^2 d\phi dr)} \cdot R\beta \cdot da =$$

0.18 0.14 0.105
~~0.74~~ 0.35 0.27
 0.57 70 735
 126 42 210
 90 0.0490 0.02835
 0.1026
 0.0490
 0.02835
 0.0554

0.045
 0.070
 0.046
 0.030
 0.018
 0.0026
 4) 0.2216
 0.0554

0.0235
 0.16
 1410
 235
 0.003760

0.2353
 0.0235

$$\chi=2, \quad \frac{d\phi}{\gamma_0 d\phi dx} = \frac{4x9}{\{14-4x\}^2} \left[1 + \frac{2x(1+x)}{(10-8x)} \frac{4(1+x)}{(14-4x)} - \frac{9(1-x)}{(10-8x)} \right]$$

$$= \frac{9}{(7-2x)^2} \left[1 + \frac{2(1+x)}{5-4x} \frac{4(1+x)}{7-2x} - \frac{9(1-x)}{5-4x} \frac{4(1+x)}{7-2x} \right]$$

$\chi=-1, \quad \frac{9}{(7+2)^2} \left[1 + \frac{2}{5+4} \right] = 0.111$

$\chi=-0.8, \quad \frac{9}{(8.6)^2} \left[1 + \frac{0.2}{8.2} \left\{ \frac{0.4}{8.6} - \frac{0.9}{8.2} \right\} \right] = 0.120$

$\chi=-0.6, \quad \frac{9}{(8.2)^2} \left[1 + \frac{0.2}{7.4} \left\{ \frac{0.8}{8.2} - \frac{0.8}{7.4} \right\} \right] = 0.128$

$\chi=-0.4, \quad \frac{9}{(7.8)^2} \left[1 + \frac{0.6}{6.6} \left\{ \frac{1.2}{7.8} - \frac{1.4}{6.6} \right\} \right] = 0.137$

$\chi=0.2, \quad \frac{9}{(7.4)^2} \left[1 + \frac{0.8}{5.8} \left\{ \frac{1.6}{7.4} - \frac{1.2}{5.8} \right\} \right] = 0.147$

$$\frac{4}{8} \frac{2}{14} = \frac{4}{4} \frac{4}{8} = \frac{4}{2}$$

$$\frac{0.10}{8.2} \frac{0.2}{8.2} = \frac{0.02}{800}$$

$$\frac{0.05}{8.6} \frac{0.05}{4.1} = \frac{0.0025}{190}$$

$$\frac{0.985}{8.865} = \frac{0.12}{8865}$$

$$\frac{0.12}{8.6} \frac{0.65}{7.96} = \frac{0.0078}{14690}$$

$$\frac{1.95}{3.7} \frac{0.047}{3.7} = \frac{0.025}{259}$$

$$\frac{1.95}{3.7} \frac{0.047}{3.7} = \frac{0.025}{259}$$

$$\frac{1.95}{3.7} \frac{0.047}{3.7} = \frac{0.025}{259}$$

$$\frac{0.12}{8.2} \frac{0.128}{8.2} = \frac{0.0015}{50820}$$

$$\frac{0.12}{8.2} \frac{0.128}{8.2} = \frac{0.0015}{50820}$$

$$\frac{0.955}{6.6} \frac{0.399}{6.6} = \frac{0.036}{330}$$

$$\frac{0.154}{3.9} \frac{0.639}{3.9} = \frac{0.024}{150}$$

$$\frac{0.137}{1.1} \frac{0.897}{1.1} = \frac{0.121}{1.21}$$

$$\frac{0.137}{1.1} \frac{0.897}{1.1} = \frac{0.121}{1.21}$$

$$\frac{0.137}{1.1} \frac{0.897}{1.1} = \frac{0.121}{1.21}$$

$$\frac{0.929}{8.343} = \frac{0.111}{104.17}$$

$$\frac{0.929}{8.343} = \frac{0.111}{104.17}$$

$$\frac{2.927}{2.51} \frac{0.219}{2.51} = \frac{0.251}{625}$$

$$\frac{1.48}{1.26} \frac{1.60}{1.45} = \frac{1.50}{145}$$

$$\frac{2.927}{2.51} \frac{0.219}{2.51} = \frac{0.251}{625}$$

$$\frac{2.927}{2.51} \frac{0.219}{2.51} = \frac{0.251}{625}$$

$$\frac{2.927}{2.51} \frac{0.219}{2.51} = \frac{0.251}{625}$$

$$\frac{7.4}{5.18} \frac{2.927}{5.18} = \frac{2.927}{5.18}$$

$$\frac{7.4}{5.18} \frac{2.927}{5.18} = \frac{2.927}{5.18}$$

$\frac{3 \times 8 \times 8}{8 \times 8 \times 8}$

$x=0: \frac{9}{49} \left[1 + \frac{1}{15} \left\{ \frac{2}{7} - \frac{9}{10} \right\} \right] = 0.156$

$$\begin{array}{r} 0.286 \\ 7 \overline{) 2.14} \\ \underline{14} \\ 60 \\ \underline{56} \\ 40 \end{array}$$

$x=0.2: \frac{9}{(6.6)^2} \left[1 + \frac{1.2}{4.2} \left\{ \frac{2.4}{6.6} - \frac{9 \times 0.8}{2 \times 4.2} \right\} \right]$

$= \frac{1}{(2.2)^2} \left[1 + \frac{2}{7} \left\{ \frac{4}{14} - \frac{6}{7} \right\} \right] = 0.177$

$$\begin{array}{r} 0.857 \\ 7 \overline{) 6.857} \\ \underline{56} \\ 1257 \\ \underline{119} \\ 667 \\ \underline{63} \\ 37 \\ \underline{35} \\ 20 \end{array}$$

$$\begin{array}{r} 0.9 \\ 5 \overline{) 0.614} \\ \underline{0.45} \\ 164 \\ \underline{150} \\ 140 \\ \underline{135} \\ 50 \end{array}$$

$49) 7.623 \quad (0.1556)$

$$\begin{array}{r} 2.2 \\ 2.2 \\ 4.4 \\ \underline{4.4} \\ 0.004 \end{array}$$

$$\begin{array}{r} 0.857 \\ 0.264 \\ \underline{0.493} \\ 0.857 \end{array}$$

$7) 0.986$

$$\begin{array}{r} 0.141 \\ 0.117 \\ \underline{0.117} \\ 0.024 \\ 484) 0.857 \\ \underline{375} \\ 388 \\ \underline{362} \\ 26 \\ \underline{232} \end{array}$$

$x=0.4: \frac{9}{(6.2)^2} \left[1 + \frac{1.4}{3.4} \left\{ \frac{2.8}{6.2} - \frac{5.4}{2 \times 3.4} \right\} \right] = \frac{9}{(6.2)^2} \left[1 + \frac{0.7}{1.7} \left\{ \frac{1.4}{3.1} - \frac{2.7}{3.4} \right\} \right]$

$$\begin{array}{r} 0.994 \\ 34) 298 \\ \underline{320} \\ 78 \\ \underline{70} \\ 80 \end{array}$$

$= 0.20$

$x=0.6: \frac{9}{(5.8)^2} \left[1 + \frac{1.6}{2.6} \left\{ \frac{3.2}{5.8} - \frac{3.6}{5.1} \right\} \right] = 0.245$

$$\begin{array}{r} 0.457 \\ 51) 124 \\ \underline{160} \\ 155 \\ \underline{150} \\ 50 \end{array}$$

$$\begin{array}{r} 0.692 \\ 139) 28 \\ \underline{120} \\ 119 \\ \underline{119} \\ 0 \end{array}$$

$$\begin{array}{r} 0.794 \\ 61452 \\ \underline{0.342} \\ 2394 \end{array}$$

$$\begin{array}{r} 0.14 \\ 0.8 \\ \underline{0.8} \\ 0.12 \\ 104) 104 \\ \underline{104} \\ 0 \end{array}$$

$$\begin{array}{r} 0.44 \\ 1.7) 0.4394 \\ \underline{0.68} \\ 68 \end{array}$$

$$\begin{array}{r} 0.859 \\ 7731 \\ \underline{3849} \\ 38818 \\ \underline{4300} \end{array}$$

$$\begin{array}{r} 5.8 \\ 28 \\ \underline{5.8} \\ 20 \\ 290 \\ \underline{290} \\ 0 \end{array}$$

$$\begin{array}{r} 0.245 \\ 3264) 82251 \\ \underline{6528} \\ 16971 \\ \underline{13440} \\ 3531 \end{array}$$

$$x=0.8: \frac{9}{(5.4)^2} \left[1 + \frac{1.8}{1.8} \left\{ \frac{3.6}{5.4} - \frac{1.8}{3.6} \right\} \right] = 0.360$$

$$\begin{array}{r} 3.24) 1.167 \\ \underline{972} \\ 1950 \\ \underline{1944} \\ 66 \end{array}$$

$$x=1.0: \frac{9}{25} \left[1 + \frac{2}{1} \frac{4}{5} \right] = 0.936$$

$$\begin{array}{r} 2.6 \\ \underline{23.4} \\ 25) 27.4 \\ \underline{225} \\ 90 \\ \underline{90} \\ 150 \end{array}$$

~~$x=1.0$~~

$\delta = \frac{d\phi}{\gamma_{\text{max}} x}$

$x = -1$	0.111	0.120	0.128	0.137	0.147	0.156	0.177	0.201	0.245	0.360	0.936
	-0.8	-0.6	-0.4	-0.2	0	+0.2	0.4	0.6	0.8	1	

$$x=0.9: \frac{9}{(5.2)^2} \left[1 + \frac{1.9}{1.4} \left\{ \frac{3.8}{5.2} - \frac{0.9}{2.8} \right\} \right] = 0.518$$

$$\begin{array}{r} 0.731 \\ \underline{26) 182} \\ 88 \\ \underline{94} \\ 20 \end{array}$$

$$\begin{array}{r} 0.322 \\ \underline{28) 984} \\ 60 \\ \underline{56} \\ 40 \end{array}$$

$$\begin{array}{r} 0.556 \\ \underline{1.405) 779} \\ 70 \\ \underline{79} \\ 90 \\ \underline{90} \\ 0 \end{array}$$

$$\begin{array}{r} 0.41 \\ \underline{0.41} \\ 0.41 \\ \underline{0.41} \\ 0.00 \end{array}$$

$$\begin{array}{r} 0.518 \\ \underline{1.405) 779} \\ 70 \\ \underline{79} \\ 90 \\ \underline{90} \\ 0 \end{array}$$

$x=1 \quad -0.8$

$$\varepsilon = \frac{4+x}{4} - \frac{1+x}{1+x} - \frac{1}{2}$$

$$= \frac{4.5+x}{3.5} - \frac{x}{2}$$

$$\varepsilon = \frac{9+2(1+x)}{9-2(1+x)} \approx \quad | \quad 1.093 \quad 1.195 \quad 1.308 \quad 1.432 \quad 1.571 \quad 1.721 \quad 1.803$$

$$\approx \frac{11+2x}{7-2x} = \frac{5.5+x}{3.5-x}$$

$$\approx 1 + \frac{2x}{7-2x}$$

$$3.1) 9.9 \quad 1.6$$

$$3.9) 14.1 \quad 3.6$$

$$5.4) 12.6 \quad 2.3$$

$$8.6) 19.4 \quad 2.2$$

$$11.8) 10.2$$

$$3.9) 5.1$$

$$1.308$$

$$3.9) 3.9$$

$$1.20$$

$$1.17$$

$$300$$

$$3.3) 5.1$$

$$8.2) 9.8$$

$$1.60$$

$$7.80$$

$$7.38$$

$$4.20$$

$$1.721$$

$$3.1) 5.9$$

$$2.80$$

$$2.79$$

$$1.00$$

$$1.803$$

$$3.1) 5.9$$

$$2.80$$

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$$1.803$$

$$3.1) 5.9$$

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$$8.2) 9.8$$

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$$3.1) 5.9$$

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$$1.803$$

$$3.1) 5.9$$

$$2.80$$

$$2.79$$

$$1.00$$

$$1.195$$

$$8.2) 9.8$$

$$1.60$$

$$7.80$$

$$7.38$$

$$4.20$$

$$1.721$$

$$3.1) 5.9$$

$$2.80$$

$$2.79$$

$$1.00$$

$$1.803$$

$$3.1) 5.9$$

$$2.80$$

$$2.79$$

$$1.00$$

$$1.195$$

$$8.2) 9.8$$

$$1.60$$

$$7.80$$

$$7.38$$

$$4.20$$

$$1.721$$

$$\xi = \frac{k}{\sqrt{1-\beta^2}} \quad \beta^2 = 1 - \beta^{-2} \quad \beta = \frac{1}{\sqrt{1-\xi^2}} = \sqrt{\frac{1-\xi^2}{\xi^2}}$$

x	β^2	β	β^{-2}	β^{-1}	$\beta^{-2} - 1$	$\beta^{-1} - \sqrt{\frac{1-\xi^2}{\xi^2}}$	ξ
-1	-0.8	-0.6	1.5	1.67	0.5	0.17	0.41
0.111	0.120	0.128	0.137	0.147	0.156	0.167	0.178
ξ	1.093	1.195	1.308	1.432	1.571	1.727	1.903
β	0.470	0.548	0.647	0.776	0.916	1.086	1.280
R_{plum}	0.0035	0.012	0.025	0.05	0.08	0.11	0.145

$\frac{d\phi}{r_{\text{plum}}}$

$\frac{1}{2} \int \dots$

Handwritten calculations and tables on the right side of the page, including:

- Table with columns for ξ and β values.
- Long division calculations for β^{-1} and β^{-2} .
- Calculus steps for $\frac{d\phi}{r_{\text{plum}}}$.

$$\begin{array}{r} 0.2 \\ 0.15 \\ \hline 0.05 \\ 0.046 \\ \hline \end{array}$$

$$\int_{-1}^{+1} RP\left(\frac{d\phi}{r^2 d\Omega da}\right) da = 0.0985 \quad 0.09057$$

$$\begin{array}{r} 1.1454 \\ 0.3 \\ \hline 2) 0.4362 \\ 0.2181 \\ \hline 2) 0.232670 \\ 0.1663 \end{array} \quad \begin{array}{r} 0.878 \\ 0.265 \\ \hline 4390 \\ 5268 \\ 1756 \\ \hline 2) 0.232670 \\ 0.1663 \end{array} \quad \begin{array}{r} 0.605 \\ 4.022 \\ \hline 1210 \\ 0.13310 \\ \hline 0.069590 \\ 0.048384 \end{array} \quad \begin{array}{r} 0.446 \\ 0.165 \\ \hline 2230 \\ 2276 \\ 446 \\ \hline 0.069590 \\ 0.048384 \end{array} \quad \begin{array}{r} 0.378 \\ 0.128 \\ \hline 3024 \\ 756 \\ 378 \\ \hline 0.048384 \end{array}$$

$$\begin{array}{r} 0.333 \\ 0.095 \\ \hline 285 \\ 285 \\ \hline 0.031635 \end{array} \quad \begin{array}{r} 0.303 \\ 0.065 \\ \hline 1515 \\ 1818 \\ \hline 0.019695 \end{array} \quad \begin{array}{r} 0.284 \\ 0.0385 \\ \hline 1420 \\ 1988 \\ 882 \\ \hline 0.0106500 \end{array} \quad \begin{array}{r} 0.265 \\ 0.0075 \\ \hline 995 \\ 1885 \\ \hline 0.019345 \end{array} \quad \begin{array}{r} 0.248 \\ 0.0078 \\ \hline 1984 \\ 1736 \\ \hline 0.0019344 \end{array} \quad \begin{array}{r} 0.231 \\ 0.0018 \\ \hline 1848 \\ 231 \\ \hline 0.0004158 \end{array}$$

$$\begin{array}{r} 0.265 \\ 0.0185 \\ \hline 1325 \\ 2120 \\ 265 \\ \hline 0.0049025 \end{array}$$

$$\begin{array}{r} 0.4362 \\ 0.23267 \\ 0.13310 \\ 0.06959 \\ 0.048384 \\ 0.031635 \\ 0.019695 \\ 0.010650 \\ 0.0049025 \\ 0.0019344 \\ 0.0004158 \\ \hline 0.989341 \end{array}$$

$$\begin{array}{r} 0.906 \\ 0.16 \\ \hline 4236 \\ 206 \\ \hline 11296 \end{array}$$

$$\begin{array}{r} 0.2181 \\ 0.1663 \\ 0.1331 \\ 0.0696 \\ 0.0484 \\ 0.0316 \\ 0.0197 \\ 0.0108 \\ 0.0049 \\ 0.0019 \\ 0.0004 \\ \hline 0.9057 \end{array}$$

~~$\frac{1+x}{2}$~~
 x -1 -0.8 -0.6 -0.4 -0.2 0 +0.2 +0.4 +0.6 +0.8 +0.9 1
 $\sqrt{\frac{1+x}{2}}$ 0 $\frac{0.316}{0.0001}$ 0.472 0.548 0.632 0.707 0.775 0.837 0.894 0.949 0.975 1.000

.158 .394 .510 .590.669 .741 .806 .866 .922 .957 .987

0.2181
 $\frac{0.987}{15267}$
 $\frac{17448}{2189}$
 $\frac{408649}{19629}$
 $\frac{0.1591491}{0.2152647}$

0.1663
 $\frac{0.957}{11641}$
 $\frac{8315}{14967}$
 $\frac{0.1591491}{0.2152647}$

0.11371
 $\frac{0.922}{2662}$
 $\frac{2662}{11999}$
 $\frac{0.1227182}{0.16602736}$

0.0696
 $\frac{0.866}{4176}$
 $\frac{4176}{5568}$
 $\frac{0.0602736}{0.0390104}$

0.0484
 $\frac{0.806}{2904}$
 $\frac{2904}{3872}$
 $\frac{0.0390104}{0.0234156}$

0.0316
 $\frac{0.747}{316}$
 $\frac{316}{1264}$
 $\frac{2212}{0.0234156}$

0.0019
 $\frac{0.0049}{0.51}$
 $\frac{0.0049}{0.0000632}$

0.0049
 $\frac{0.51}{49}$
 $\frac{0.002499}{0.00786}$

0.0107
 $\frac{0.590}{963}$
 $\frac{535}{0.006313}$

0.2153
 0.1591
 0.1227
 0.0623
 0.0390
 0.0254
 0.0132
 0.0063
 0.0025
 0.0009
 0.0001
 0.6446

0.6446
 $\frac{16}{36676}$
 $\frac{6446}{101136}$

DEPARTMENT OF PHYSICS
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