# NUEN 301
# Test 3

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## 1 Problem 0

"The work that I am turning in is my own. I did not work with others nor did I communicate my answers to others. An Aggie does not lie, cheat or steal, or tolerate those who do."

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## 2 Problem 1

a) $W_235\frac{M_u}{M_235} + W_238\frac{M_u}{M_238} = 1$

$\frac{1}{M_u} = \frac{W_235}{M_235} + \frac{W_238}{M238}$

$M_u = \frac{1}{\frac{0.935}{235}+\frac{0.065}{238}} = 235.19$

$\Sigma_a = \frac{(18.74)(1.602*10^{23}}{235.19}(0.935\frac{235.19}{235}1.65*10^{-24} + 0.065\frac{235.19}{238}0.255*10^{-24}) = 0.0199[cm^{-1}]$

$\Sigma_{transport} = \frac{(18.74)(1.602*10^{23}}{235.19}(0.935\frac{235.19}{235}6.80*10^{-24}+0.065\frac{235.19}{238}6.90*10^{-24}) = 0.0870[cm^{-1}]$

$\Sigma_f = \frac{(18.74)(1.602*10^{23}}{235.19}(0.935\frac{235.19}{235}1.40*10^{-24} + 0.065\frac{235.19}{238}0.095*10^{-24}) = 0.0168[cm^{-1}]$

b) $D = \frac{1}{3\Sigma_{transport}} = \frac{1}{3(0.0870)} = 3.83$

c) $L = \sqrt{\frac{D}{\Sigma_a}} = \sqrt{\frac{3.83}{0.0199}} = 13.87$

d) $1 = k = \frac{v\Sigma_f}{\Sigma_a + DB_g} \Rightarrow B_g = \frac{v\Sigma_f - \Sigma_a}{D} = \frac{(2.60)(0.0168) - 0.0199}{3.83} = 0.00621$

e) $B_g^2 = \frac{\pi}{\tilde{R}} \Rightarrow \tilde{R} = \frac{\pi}{B_g} = \frac{\pi}{0.006221} = 505.89[cm]$

f) $\tilde{R} = R + 2D \Rightarrow R = \tilde{R} - 2D = 505.89 - 2(3.83) = 498.32[cm]$

# 3 Problem 2

1) a) $0 \leq x \leq a \quad -D_1\frac{d^2\phi_1}{dx^2} + \Sigma_{a,1}\phi_1(x) = S_1$

$\phi_1(x) = A_1 cosh(\frac{x}{L_1} + C_1 sinh(\frac{x}{L_1}) + \frac{S_1}{\Sigma_{a,1}}$

b) $a \leq x \leq b \quad -D_2\frac{d^2\phi_2}{dx^2} + \Sigma_{a,2}\phi_2(x) = 0$

$\phi_2(x) = A_2 cosh(\frac{x}{L_2} + C_2 sinh(\frac{x}{L_2})$

c) $J_{x,1}(0) = -D_1\frac{d\phi_1}{dx}|_0 = 0$
$\phi_2(b + 2D_2) = 0$

d) $\phi_1(a) = \phi_2(a)$
$-D_1\frac{d\phi_1}{dx}|_a = -D_2\frac{d\phi_2}{dx}|_a$

e) $\frac{d\phi_1}{dx} = \frac{A_1}{L_1} sinh(\frac{x}{L_1}$

$\frac{d\phi_1}{dx}|_0 = \frac{C_1}{L_1} \Rightarrow C_1 = 0$

$\phi_2(\tilde{b}) = 0 = A_2 cosh(\frac{a-\tilde{b}}{L_2}) + C_2 sinh(\frac{a-\tilde{b}}{L_2})$

$\phi_1(a) = \phi_2(a) \Rightarrow A_1 conh(\frac{a}{L_1}) + \frac{S_1}{\Sigma_{a,1}}) = A_2$

$-D_1 \frac{d\phi_1}{dx}|_a = -D_2 \frac{d\phi_2}{dx}|_a \Rightarrow -D_1 \frac{A_1}{L_1} sinh(\frac{a}{L_1} = -D_2 \frac{C_2}{L_2}$

$$\begin{bmatrix} 0 & cosh(\frac{a-\tilde{b}}{L_2}) & sinh(\frac{a-\tilde{b}}{L_2}) \\ cosh(\frac{a}{L_1}) & -1 & 0 \\ \frac{D_1}{L_1} sinh(\frac{a}{L_1}) & 0 & \frac{D_2}{L_2} \end{bmatrix} \begin{bmatrix} A_1 \\ A_2 \\ C_2 \end{bmatrix} = \begin{bmatrix} 0 \\ \frac{-S_1}{\Sigma_{a,1}} \\ 0 \end{bmatrix}$$

$L_1 = 2.236 \quad L_2 = 3.162 \quad \tilde{b} = 15$

$$\begin{bmatrix} 0 & cosh(\frac{5-15}{3.162}) & sinh(\frac{5-15}{3.162}) \\ cosh(\frac{5}{2.236}) & -1 & 0 \\ \frac{1}{2.236} sinh(\frac{5}{2.236}) & 0 & \frac{3}{3.162} \end{bmatrix} \begin{bmatrix} A_1 \\ A_2 \\ C_2 \end{bmatrix} = \begin{bmatrix} 0 \\ \frac{-3}{0.2} \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 11.84 & -11.80 \\ 4.7314 & -1 & 0 \\ 2.068 & 0 & 0.9487 \end{bmatrix} \begin{bmatrix} A_1 \\ A_2 \\ C_2 \end{bmatrix} = \begin{bmatrix} 0 \\ -15 \\ 0 \end{bmatrix}$$

$A_1 = -2.173 \quad A_2 = 4.720 \quad C_2 = 4.736$

f) $\phi_1(x) = -2.173 cosh(\frac{x}{2.236}) + 15$

$\phi_2(x) = 4.72 cosh(\frac{x-15}{3.873} + 7.736 sinh(\frac{x-15}{3.873})$

g)$\phi_1(0) = -2.173 cosh(\frac{0}{2.236}) + 15 = 12.83$

$\phi_1(\frac{a}{2}) = -2.173 cosh(\frac{2.5}{2.236}) + 15 = 11.32$

$\phi_1(a) = -2.173 cosh(\frac{5}{2.236}) + 15 = 4.72$

$\phi_2(9) = 4.72cosh(\frac{9-15}{3.873} + 7.736sinh(\frac{9-15}{3.873}) = 0.967$

2)

a)$ARR = A\Sigma_a \int_0^a$

# 4 Problem 3

1)a) $\phi(x) = Acosh(\frac{x-x_0}{L}) + Csinh(\frac{x-x_0}{L})$

b) $\phi(a) = 0$

$J(x_0) = \frac{S}{2} = \frac{d\phi}{dx}|_{x_0} = \frac{S}{2}$

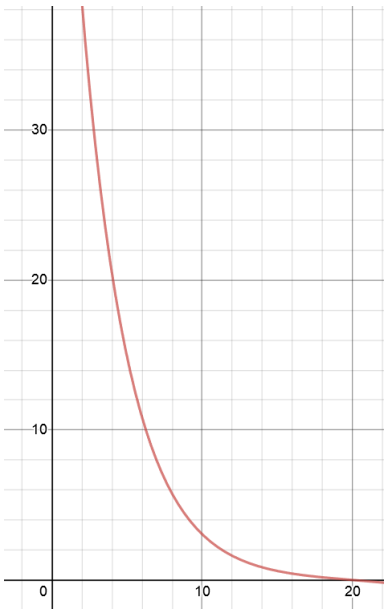
c) $L = 3.16$

$\phi(a) = Acosh(\frac{x-x_0}{L}) + Csinh(\frac{x-x_0}{L}) = Acosh(\frac{20-7}{3.16}) + Csinh(\frac{20-7}{3.16}) = 30.6A + 30.584C = 0$

$\frac{d\phi}{dx}|_{x_0} = \frac{-A}{L}sinh(\frac{x_0-x_0}{L}) + \frac{-C}{L}cosh(\frac{x_0-x_0}{L}) = \frac{-C}{L} = \frac{S}{2} \Rightarrow \frac{-C}{3.16} = \frac{5}{2} \Rightarrow C = -7.9$

$30.6A + 30.584(-7.9) = 0 \Rightarrow A = 7.896$

$\phi(x) = -7.896cosh(\frac{x-7}{3.16} + 7.9sinh(\frac{x-7}{1.36})$
2)




| x | $\phi$ |
|---|---|
| 2.5 | 32.81 |
| 5 | 14.87 |
| 7 | 7.90 |
| 7.5 | 6.24 |
| 10 | 3.051 |
| 12.5 | 1.324 |
| 15 | 0.603 |
| 17.5 | 0.229 |

# 5 Problem 4