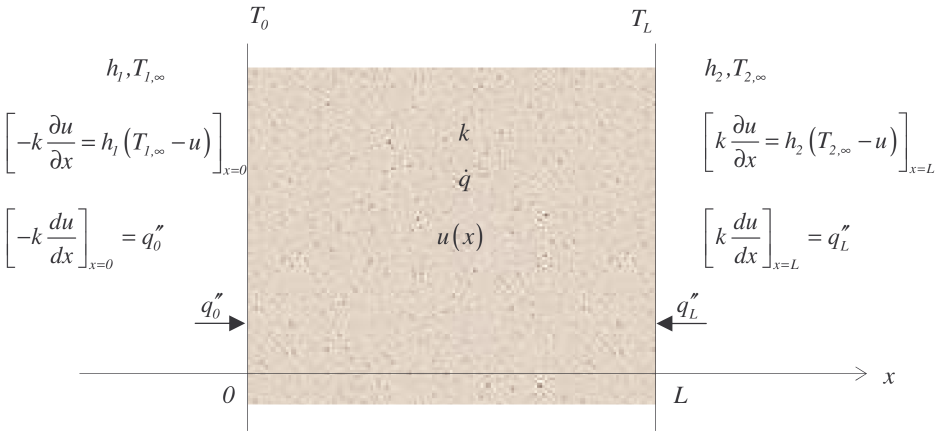
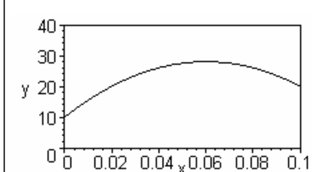
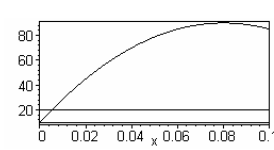
Steady State Conduction in the Plane Wall with Uniform Heat Generation

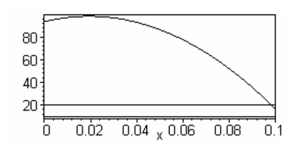


$$\frac{d^2u}{dx^2} + \frac{\dot{q}}{k} = 0 \qquad x \in (0, L)$$

$x = 0 \qquad [u]_{x=0}$

$x = L \qquad [u]_{x=L}$

Boundary Conditions	**Solution**	Plot temperature for:
$\left[-k\frac{\partial u}{\partial x} = h_1\left(T_{1,\infty} - u\right)\right]_{x=0}$ $\left[k\frac{\partial u}{\partial x} = h_2\left(T_{2,\infty} - u\right)\right]_{x=L}$	$u(x)$ *temperature distribution* $q''(x) = -k\frac{\partial u(x)}{\partial x}$ *heat flux*	$L = 0.1$ $k = 20$ $T_0 = T_1 = T_{1,\infty} = 10$ $h_1 = 100$ $T_L = T_2 = T_{2,\infty} = 20$ $h_2 = 200$ $\dot{q} = 200000$ $q_0'' = -12000$ $q_L'' = -10000$
D $[u]_{x=0} = T_0$ **D** $[u]_{x=L} = T_L$	$u(x) = -\frac{\dot{q}x^2}{2k} + \left(\frac{T_2 - T_1}{L} + \frac{\dot{q}L}{2k}\right)x + T_1$ $q''(x) = \dot{q}\left(x - \frac{L}{2}\right) + k\frac{T_1 - T_2}{L}$	
N $[u']_{x=0} = -q_0''/k$ $[-ku']_{x=0} = q_0''$ **D** $[u]_{x=L} = T_L$	*Kevin Jeffs* $u(x) = \frac{\dot{q}}{2k}\left(L^2 - x^2\right) + \frac{q_0''}{k}(L - x) + T_L$	
D $[u]_{x=0} = T_0$ **N** $[u']_{x=L} = q_L''/k$ $[-ku']_{x=L} = -q_L''$	*Kevin Jeffs* *James Hall* $u(x) = -\frac{\dot{q}x^2}{2k} + \left(q_L'' + \dot{q}L\right)\frac{x}{k} + T_0$ $q''(x) = \dot{q}(x - L) - q_L''$	
N $[u']_{x=0} = -q_0''/k$ $[-ku']_{x=0} = q_0''$ **N** $[u']_{x=L} = q_L''/k$ $[-ku']_{x=L} = -q_L''$	*Ill-set Boundary Value problem*	

D $[u]_{x=0}=T_0$ **R** $[ku'+h_2u]_{x=L}=h_2T_{2,\infty}$	*Justin Baker* $u(x)=-\frac{\dot{q}x^2}{2k}+\left[\frac{h_2\left(T_{2,\infty}-T_0\right)+\dot{q}L\left(\frac{h_2L}{2k}+1\right)}{k+h_2L}\right]x+T_0$ $q''(x)=\dot{q}x-k\left[\frac{h_2\left(T_{2,\infty}-T_0\right)+\dot{q}L\left(\frac{h_2L}{2k}+1\right)}{k+h_2L}\right]$	
N $[u']_{x=0}=-q_0''/k$ **R** $\left[ku'+h_2u=h_2T_{2,\infty}\right]_{x=L}$	*Ryan Lewis* $u(x)=\dot{q}\left(\frac{L^2}{2k}+\frac{L}{h_2}-\frac{x^2}{2k}\right)+q_0''\left(\frac{L}{k}+\frac{1}{h_2}-\frac{x}{k}\right)+T_{2,\infty}$ *Matthew Bloxham* $u(x)=\frac{\dot{q}}{2k}\left(L^2-x^2\right)+\frac{q_0''}{k}(L-x)+\frac{1}{h_2}\left(q_0''+\dot{q}L\right)+T_{2,\infty}$ $q''(x)=\dot{q}x+q_0''$	
R $\left[-ku'+h_1u=h_1T_{1,\infty}\right]_{x=0}$ **D** $[u]_{x=L}=T_L$	*Kevin Jeffs* $u(x)=-\frac{\dot{q}x^2}{2k}+h_1\left(\frac{\frac{\dot{q}L^2}{2k}+T_0-T_{1,\infty}}{k+Lh_1}\right)x+\frac{\frac{\dot{q}L^2}{2}+kT_0+h_1L}{k+Lh_1}$ *Curtis Memory* $u(x)=-\frac{\dot{q}x^2}{2k}+\frac{1}{\frac{k}{h_1}+L}\left(\frac{T_LL}{2k}-\dot{q}L^2-T_1\right)x+$ $+T_1-\frac{k}{h_1}\frac{1}{\frac{k}{h_1}+L}\left(\frac{T_LL}{2k}-\dot{q}L^2-T_1\right)$ $q''(x)=-\frac{\dot{q}x}{k}+\frac{1}{\frac{k}{h_1}+L}\left(\frac{T_LL}{2k}-\dot{q}L^2-T_1\right)$	
R $\left[-ku'+h_1u=h_1T_{1,\infty}\right]_{x=0}$ **N** $[u']_{x=L}=q_L''/k$	*Justin Baker* *Ryan Lewis* $u(x)=-\frac{\dot{q}x^2}{2k}+\frac{q_L''+\dot{q}L}{k}x+\frac{q_L''+\dot{q}L}{h_1}+T_{1,\infty}$ $q''(x)=\dot{q}(x-L)-q_L''$	
R $\left[-ku'+h_1u=h_1T_{1,\infty}\right]_{x=0}$ **R** $\left[ku'+h_2u=h_2T_{2,\infty}\right]_{x=L}$	$u(x)=-\frac{\dot{q}x^2}{2k}+c_1x+c_2$ $q''(x)=\dot{q}x+c_1$ $c_1=\frac{T_{2,\infty}-T_{1,\infty}+\dot{q}L\left(\frac{1}{h_2}+\frac{L}{2k}\right)}{L+\left(\frac{1}{h_1}+\frac{1}{h_2}\right)k}$ $c_2=\frac{\frac{\dot{q}L}{h_1}\left(\frac{k}{h_2}+\frac{L}{2}\right)+k\left(\frac{T_{2,\infty}}{h_1}+\frac{T_{1,\infty}}{h_2}\right)+T_{1,\infty}L}{L+\left(\frac{1}{h_1}+\frac{1}{h_2}\right)k}$