MECH 3460 Heat Transfer: **Fin Equation Summary**			
Fins of Uniform Cross-Sectional Area			
Case	Tip Condition	Temperature Distribution $\dfrac{\theta(x)}{\theta_b}$	Fin Heat Rate, q_f [W]
A	Convection	$\dfrac{\left[\cosh(m(L-x)) + \left(\dfrac{h}{m\,k}\right)\sinh(m(L-x))\right]}{\left[\cosh(mL) + \left(\dfrac{h}{m\,k}\right)\sinh(mL)\right]}$	$M\dfrac{\left[\sinh(mL) + \left(\dfrac{h}{m\,k}\right)\cosh(mL)\right]}{\left[\cosh(mL) + \left(\dfrac{h}{m\,k}\right)\sinh(mL)\right]}$
B	Adiabatic	$\dfrac{\cosh(m(L-x))}{\cosh(mL)}$	$M\tanh(mL)$
C	Temperature Specified	$\dfrac{\left[\left(\dfrac{\theta_L}{\theta_b}\right)\sinh(m\,x) + \sinh(m(L-x))\right]}{\sinh(mL)}$	$M\dfrac{\left[\cosh(mL) - \left(\dfrac{\theta_L}{\theta_b}\right)\right]}{\sinh(mL)}$
D	Infinite Length	$e^{-m\,x}$	M

$\theta(x) = (T(x) - T_\infty)$
$\theta_b = (T_b - T_\infty) = (T(0) - T_\infty)$
$\theta_L = (T_L - T_\infty) = (T(L) - T_\infty)$
$m = \left[\dfrac{h\,P}{k\,A_c}\right]^{1/2}$
$M = \theta_b\,[h\,P\,k\,A_c]^{1/2}$

$P \equiv$ perimeter
$A_C \equiv$ cross-sectional area
$k \equiv$ thermal conductivity
$h \equiv$ convection heat transfer coefficient
$T_b \equiv$ fin base temperature
$T_\infty \equiv$ ambient fluid temperature
$L \equiv$ fin length

$\sinh(x) = \frac{1}{2}\,(e^x - e^{-x})$
$\cosh(x) = \frac{1}{2}\,(e^x + e^{-x})$
$\tanh(x) = \dfrac{\sinh(x)}{\cosh(x)}$