Transient Conduction

$k := 0.06 \frac{W}{m K}$ Thermal Conductivity of Material

$\rho := 96 \frac{kg}{m^3}$ Density of Material

$cp := 1130 \frac{J}{kg K}$ Specific Heat of Material

$h_0 := 5.719 \frac{W}{m^2 K}$

$T_{inf} := 72 \, °F$ Surrounding Temperature

$Q_{in} := 60 \, W$ Energy tramsitted into plane

$\sigma := 5.6704 \cdot 10^{-8} \frac{W}{m^2 K^4}$ Stephan Boltzman's Constant

$A_i := 0.511 \, m^2$ $A_o := 0.511 \, m^2$

$A := \frac{(A_i + A_o)}{2}$

$L := 1 \, in$ Of cross-section

$dx := 0.1 \, in$

$time := 240 \, s$

$dt := 5 \, s$

Forward Euler Method

$diffusionNumber := \frac{k \cdot dt}{cp \cdot \rho \cdot dx^2} = 0.4287$ If less than 0.5 then it has met the stability criteria

$$\text{for } j \in \left[1, 2 .. \left(time \cdot \frac{1}{dt}\right)\right]$$
$$\text{for } i \in \left[1, 2 .. \left(L \cdot \frac{1}{dx}\right)\right]$$
$$T_{i\,j} := T_{inf}$$

$T_{1\,2} = 295.3722 \, K$ $T_{10\,2} = 295.3722 \, K$ $T_{9\,4} = 295.3722 \, K$

$$\text{for } t \in \left[1 .. \left(time \cdot \frac{1}{dt}\right)\right]$$

$$Q_{out} := \sigma \cdot A \cdot \left(\left(T_{L \cdot \frac{1}{dx}\ t}\right)^4 - T_{inf}^{\ 4}\right) + h_0 \cdot A \cdot \left(T_{L \cdot \frac{1}{dx}\ t} - T_{inf}\right)$$

$$T_{1\ t+1} := T_{1\ t} + \left(\frac{k \cdot dt}{cp \cdot \rho \cdot dx^2}\right) \cdot \left(T_{2\ t} - T_{1\ t} + Q_{in} \cdot \frac{dx}{k \cdot A_i}\right)$$

$$T_{L \cdot \frac{1}{dx}\ t+1} := T_{L \cdot \frac{1}{dx}\ t} + \left(\frac{k \cdot dt}{cp \cdot \rho \cdot dx^2}\right) \cdot \left(T_{L \cdot \frac{1}{dx} - 1\ t} - T_{L \cdot \frac{1}{dx}\ t} - Q_{out} \cdot \frac{dx}{k \cdot A_o}\right)$$

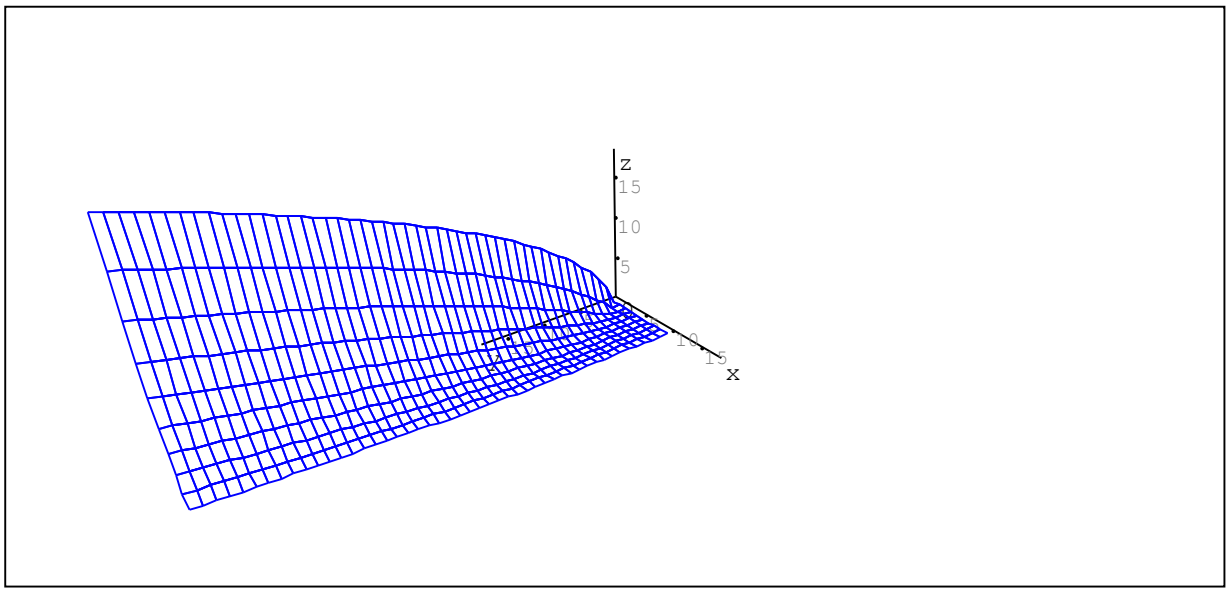
$$\text{for } x \in \left[2 .. \left(\left(L \cdot \frac{1}{dx}\right) - 1\right)\right]$$

$$T_{x\ t+1} := T_{x\ t} + \left(\frac{k \cdot dt}{cp \cdot \rho \cdot dx^2}\right) \cdot \left(T_{x-1\ t} - 2 \cdot T_{x\ t} + T_{x+1\ t}\right)$$

$$T := T - T_{inf}$$

$$TT(x, t) := \begin{bmatrix} x \\ t \\ T_{x\ t} \end{bmatrix}$$

$$T2 := \text{CreateMesh}\left(TT, 1, L \cdot \frac{1}{dx}, 1, time \cdot \frac{1}{dt}, L \cdot \frac{1}{dx} - 1, time \cdot \frac{1}{dt} - 1\right) = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 2 & 2.1307 \\ 2 & 2 & 0 \\ 2 & 1 & 0 \\ 1 & 1 & 0 \\ 1 & 2 & 2.1307 \\ 1 & 3 & 3.348 \\ 2 & 3 & 0.9133 \\ 2 & 2 & 0 \\ 1 & 2 & 2.1307 \\ & \vdots & \end{bmatrix}$$



T2