$t_1 := \text{time}(0)$

$\mu\text{rad} \equiv 10^{-6}\cdot\text{rad}$ $\quad$ $\text{mrad} \equiv 10^{-3}\cdot\text{rad}$ $\quad$ $\mu\text{m} \equiv 10^{-6}\text{m}$ $\quad$ $\text{nm} := 10^{-9}\text{m}$

$\text{ms} \equiv 10^{-3}\cdot\text{s}$ $\quad$ $\mu\text{s} \equiv 10^{-6}\text{s}$ $\quad$ $\text{ns} \equiv 10^{-9}\cdot\text{s}$ $\quad$ $\text{kt} \equiv 1852\,\frac{\text{m}}{\text{hr}}$ $\quad$ $\text{nmi} := 1852\cdot\text{m}$ $\quad$ $°\text{C} \equiv \text{K}$

$c \equiv 2.99792458\cdot 10^{8}\,\frac{\text{m}}{\text{s}}$ $\quad$ $h \equiv 6.62606876\cdot 10^{-34}\text{J}\cdot\text{s}$ $\quad$ $r_e \equiv 6378140\cdot\text{m}$ $\quad$ $\sigma \equiv 5.670400\cdot 10^{-8}\cdot\frac{\text{watt}}{\text{m}^2\cdot\text{K}^4}$

$\text{mJ} \equiv 10^{-3}\text{J}$ $\quad$ $\text{MW} \equiv 10^{6}\text{W}$ $\quad$ $\text{nW} \equiv 10^{-9}\text{W}$ $\quad$ $\mu\text{W} \equiv 10^{-6}\text{W}$ $\quad$ $\text{mW} \equiv 10^{-3}\text{W}$ $\quad$ $\text{time}(0) - t_1 = 0.0$

$T_{out} := -40\text{R}$ $\quad$ $T_{out.surf} := -39.850\ \text{R}$ $\quad$ $T_{in.surf} := -37.15000\text{R}$ $\quad$ $T_{in} := -36.70000\text{R}$

$l := 1\text{in}$ $\quad$ $k := \frac{l}{0.6\,\frac{\text{m}^2\text{K}}{\text{W}}} = 0.04233\,\frac{\text{W}}{\text{m K}}$

Given

$$10\,\frac{\text{W}}{\text{m}^2\text{K}}\left(T_{in} - T_{in.surf}\right) = \frac{k}{l}\left(T_{in.surf} - T_{out.surf}\right)$$

$$\frac{k}{l}\left(T_{in.surf} - T_{out.surf}\right) = 30\,\frac{\text{W}}{\text{m}^2\text{K}}\left(T_{out.surf} - T_{out}\right) \qquad \text{Find}\left(T_{in.surf}, T_{in}\right) = \begin{pmatrix} -37.15000 \\ -36.70000 \end{pmatrix}\text{R}$$

$\text{flux} := 30\,\frac{\text{W}}{\text{m}^2\text{K}}\left(T_{out.surf} - T_{out}\right) = 2.500\,\frac{\text{W}}{\text{m}^2}$ $\quad$ $\frac{k}{l}\left(T_{in.surf} - T_{out.surf}\right) = 2.500\,\frac{\text{W}}{\text{m}^2}$

$\frac{2.5\,\frac{\text{W}}{\text{m}^2}}{30\,\frac{\text{W}}{\text{m}^2\text{K}}} + T_{out} = -39.850\,\text{R}$ $\quad$ $\text{flux}\cdot(50\text{ft})^2 = 580.6\,\text{W}$

$T_{out} := -40\,R$ $T_{out.surf} := -37.000\,R$ $T_{in.surf} := 17.00000\,R$ $T_{in} := 26.00000\,R$

Given

$$10\,\frac{W}{m^2 K}\left(T_{in} - T_{in.surf}\right) = \frac{k}{l}\left(T_{in.surf} - T_{out.surf}\right)$$

$$\frac{k}{l}\left(T_{in.surf} - T_{out.surf}\right) = 30\,\frac{W}{m^2 K}\left(T_{out.surf} - T_{out}\right) \qquad \text{Find}\left(T_{in.surf}, T_{in}\right) = \begin{pmatrix} 17.00000 \\ 26.00000 \end{pmatrix} R$$

$$flux := 30\,\frac{W}{m^2 K}\left(T_{out.surf} - T_{out}\right) = 50.000\,\frac{W}{m^2} \qquad \frac{k}{l}\left(T_{in.surf} - T_{out.surf}\right) = 50.000\,\frac{W}{m^2}$$

$$\frac{50\,\frac{W}{m^2}}{30\,\frac{W}{m^2 K}} + T_{out} = -37.000\,R \qquad flux \cdot (50\,ft)^2 = 11612.9\,W$$