1. The following equation for the temperature $T = T(t)$ represents a spherical thermocouple with convective conditions and includes radiation exchange with its surrounding walls

$$c_2 \frac{dT}{dt} = -(T - T_\infty + c_1(T^4 - T_{sur}^4)).$$

In this equation, $c_1 = 1.27575 \times 10^{-10} K^{-3}$ and $c_2 = 0.991667s$. If it is assumed that $T_\infty = 473.15$, $T_{sur} = 673.15K$, and $T(0) = 298.15K$, determine the time t_s at which $T(t_s) = 490.85K$.

We can start by expressing our derivative in a discreet form. This gives the equation

$$c_2 \left(\frac{T(n+1) - T(n)}{\Delta t} \right) = -(T - T_\infty + c_1(T^4 - T_{sur}^4)).$$

Solving this for $T(n+1)$ gives

$$T(n+1) = -\frac{\Delta t}{c_2}(T - T_\infty + c_1(T^4 - T_{sur}^4)) + T.$$