Consider rubber sphere initially at $T_i = 25°C$ placed into boiling water at $T_\infty = 100°C$ (large h).

Sphere properties: $k = 0.15 \frac{W}{mK}$, $\rho = 1000 \frac{kg}{m^3}$, $c = 2000 \frac{J}{kg K}$ with $\alpha = \frac{k}{\rho c} = \frac{0.15 \frac{W}{mK}}{1000 \frac{kg}{m^3} \cdot 2000 \frac{J}{kg K}}$.

$\alpha = 7.5 \times 10^{-8} \frac{m^2}{s}$, $R = 0.01\ m$

Using the infinite series solution obtained in class for constant T_s, plot $T(r,t)$.

$$\theta = \frac{T(r,t) - T_\infty}{T_i - T_\infty} = \sum_{n=1}^{\infty} A_n \frac{\sin(\lambda_n r)}{\lambda_n r} \exp(-\alpha \lambda_n^2 t)$$

where $A_n = -2\cos(\lambda_n R)$, $\lambda_n = \frac{n\pi}{R}$, $n = 1, 2, 3 \ldots$

Compare the exact solution with the semi-infinite solid solution for constant T_s:

$$\frac{T(x,t) - T_s}{T_i - T_s} = \operatorname{erf}\left(\frac{x}{2\sqrt{\alpha t}}\right)$$

Note that in this expression, x is the position measured from the outer surface into the interior of the sphere.