

- 1 - 1-D radial conduction
- 2 - constant properties - ρ , c_p , k , T_{∞}
- 3 & h
- 4 - Thermal radiation neg.

✓ Data & Variables

$T_i = 70$ $T_{\infty} = 25^{\circ}\text{C}$ $T(0, t) = 30^{\circ}\text{C}$
 (cooling) $t = 1338 \text{ sec}$ $h = 20.42 \text{ W/m}^2 \cdot \text{K}$
 $\rho = 1190 \text{ kg/m}^3$ $c_p = 1465 \text{ J/kg} \cdot \text{K}$
 $k = 0.19 \text{ W/m} \cdot \text{K}$

✓ Procedure

Calculate thermal diffusivity & center temp ratio. Next the Fourier number by function of Biot number $Bi = \frac{h r_o}{k}$ & subbing into the centerline equ. $\theta_o = C_1 \exp(-S^2 \tau)$ & doing an approx. lookup (S_1 & C_1) for infinite cylinders to calc Bi . Once done calculate $\tau = \frac{Bi \cdot k}{h}$ & $D = 2r_o$. Validate $\tau > 0.2$

Lastly use zero-order Bessel function J_0 & $\theta = \theta_o J_0(S, r)$ for $1/2 r$ & surface r , then convert back to temperature using $T(r, t) = T_{\infty} + \theta (T_i - T_{\infty})$