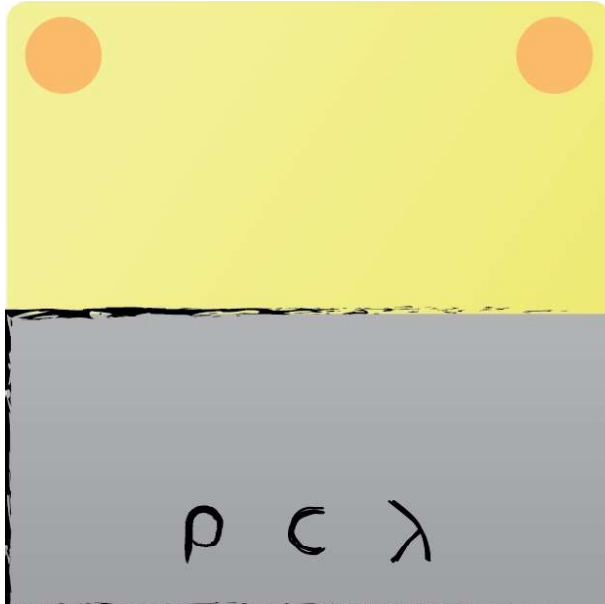


## Exam Preparation - Conduction 8



A large body is suddenly imposed to a new temperature at its surface  $T(x = 0, t > 0) = 500$  K. The body has an initial homogeneous temperature  $T(x, t = 0) = 298$  K. Determine  $T(x_1, t_1)$ , for  $t_1 = 18$  s at depth  $x_1 = 3$  mm.

Problem type:

One-dimensional, unsteady-state heat conduction inside a semi-infinite plate with negligible heat transfer resistance.

Temperature profile inside a semi-infinite plate with negligible heat transfer resistance:

$$\Theta^* = \frac{T - T_0}{T_a - T_0} = 1 - \operatorname{erf}\left(\frac{1}{\sqrt{4 \cdot \text{Fo}}}\right)$$



Determining the Fourier number:

$$\text{Fo} = \frac{\lambda \cdot t}{\rho \cdot c \cdot x^2} = 47.8515$$

Determining  $\Theta^*$ :

$$\Theta^* = 1 - \operatorname{erf}\left(\frac{1}{\sqrt{4 \cdot \text{Fo}}}\right) = 0.9186$$

Rearranging  $\Theta^*$  and filling in:

$$T = \Theta^* \cdot (T_a - T_0) + T_0 = 484 \text{ K}$$