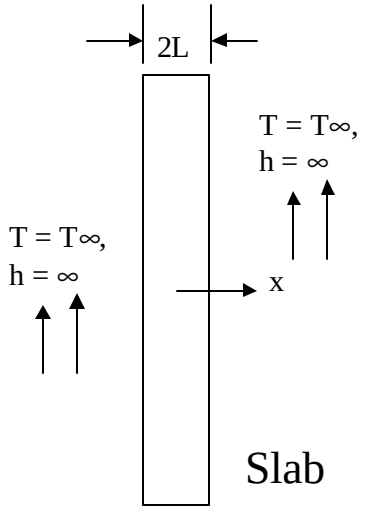
ME 323, Spring 2008, Tues. April 29

Homework #5, due Tues. May 13 beginning class, (text: Incropera & DeWitt, ID)

Reading (ID) 5.9.1 Transient Finite Difference Solution

Problem (ID):

A rectangular slab modeled below is uniformly heated to T_{init} = 100 ^{o}C. It is then placed in a well-mixed ice bath such that the surface temperature essentially instantaneously drops to T_8 = 0 ^{o}C.



- Discretize the governing equation and boundary conditions for this problem by writing in explicit finite difference form for the time dependent temperature distribution $T(x,t)$ in the slab.

$$\frac{\partial T}{\partial t} = a\,\frac{\partial^2 T}{\partial x^2} \text{ subject to}$$

Initial condition: $T(x,0) = 100\ ^{\circ}C$

Boundary conditions: $T(L,t) = 0\,^{\circ}C$

$$\left.\frac{\partial T}{\partial x}\right|_{x=0} = 0$$

- For L = 0.025m determine for $T(x,t)$, using at least 10 nodes, numerically for copper and glass.
- Repeat the calculations by increasing/decreasing the time step. Discuss your observations.
- Is there an analytic solution to compare your calculations to? If so, provide some discussion on the comparison.