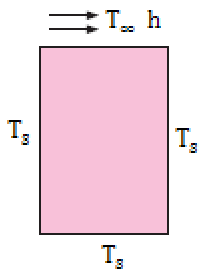
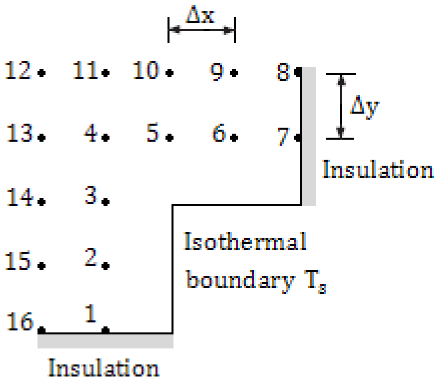
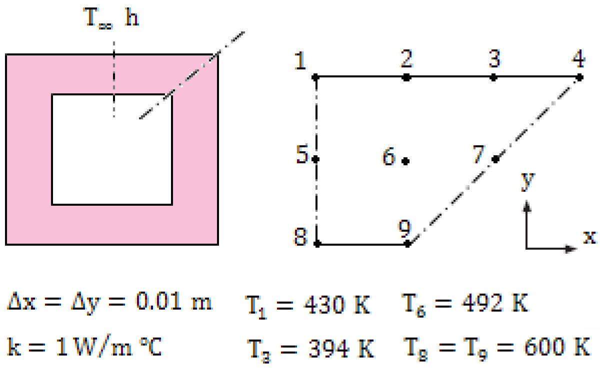
1. A long bar of rectangular cross section is 60 mm by 90 mm on a side and has thermal conductivity of 1 W/m °C. One surface is exposed to a convection process with air at 100°C and a convection coefficient of 100 W/m$^2$°C, while the remaining surfaces are maintained at 50°C. Using a grid spacing of 30 mm and the Gauss-Seidel method, determine the nodal temperatures and the heat rate per unit length normal to the page into the bar from the air.




2. Consider the two dimensional grid $(\Delta x = \Delta y)$ representing steady state conditions with no internal volumetric generation for a system with thermal conductivity k. One of the boundaries is maintained at a constant temperature $T_s$ while the others are adiabatic. Derive an expression for the heat rate per unit length normal to the page crossing the isothermal boundary $(T_s)$.

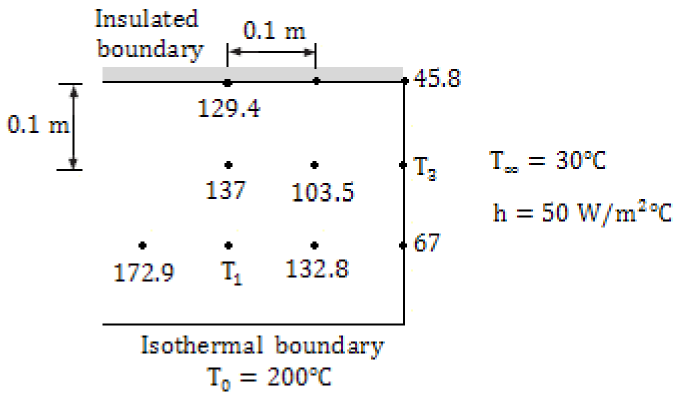



3. Consider the square channel shown in the sketch operating under steady state conditions. The inner surface of the channel is at a uniform temperature of 600 K, while the outer surface is exposed to convection with a fluid at 300 K and a convection coefficient of 50 W/m$^2$ °C. From a symmetrical element of the channel, a two dimensional grid has been constructed and the nodes labeled. The temperatures for nodes 1, 3, 6, 8 and 9 are identified.
   a) Determine the temperature $T_2$, $T_4$ and $T_7$.
   b) Calculate the heat loss per unit length of the channel.

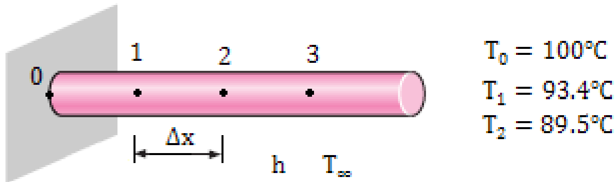


4. The steady state temperatures (°C) associated with selected nodal of a two dimensional system having a thermal conductivity of 1.5 W/m°C are shown on the accompanying grid.
   a) Determine the temperature at nodes 1, 2

   b) Calculate the heat transfer rate per unit thickness normal to the page from the system to the fluid.




5. A steady state, finite difference analysis has been performed on a cylindrical fin with a diameter of 12 mm and a thermal conductivity of 15 W/m°C. The convection process is characterized by a fluid temperature of 25°C and a heat transfer coefficient of 25 $W/m^2$°C.




   a) The temperature for the first three nodes separated by a spatial increment of $\Delta x = 10$ mm, are given in the sketch. Determine the fin heat rate.
   b) Determine the temperature at node 3, $T_3$.