SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
DEPARTMENT OF METALLURGICAL ENGINEERING

Met 422	HQ 2	Nov 19, 1997
MI 222	(open book)	2:00 PM

4. An electric heating element for a furnace is connected to the electric power source at each end by water-cooled clamps as shown below.

   The rod's temperature is a function of the distance along the axis.

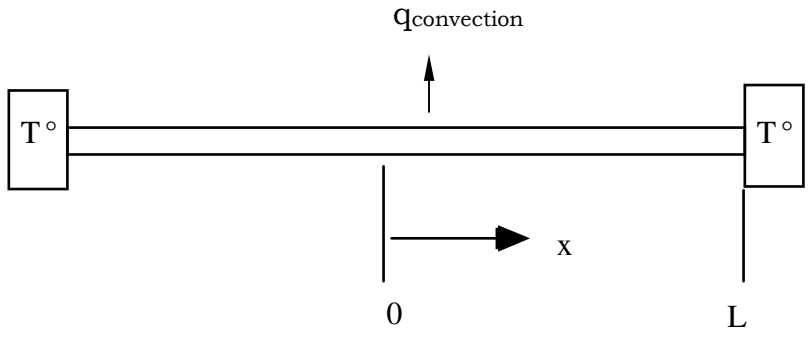
   There are no significant radial gradients.

   The electric power generates heat within the element at a rate of S Watts/cm^3.

   The rate of heat is loss per unit surface area from the surface of the rod is $q_{convection}=h(T_{Rod}-T_{air})$. Assume h is given.

   Derive an equation for the steady state axial temperature profile in a rod L in length. Since the temperature profile will be symmetrical about the center of the rod's axis, put your coordinate at the rod's center. The rod's length is 2L and its radius is R.

   Show the BC's, the finite element, the heat balance, the temperature profile equation.



SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY
DEPARTMENT OF MATERIALS & METALLURGICAL ENGINEERING

MET 422	HQ 2	Nov 7, 2000
MI 222	(open book)	11:00 AM

4. Obtain a differential equation for the temperature distribution in a sphere as a function of time and radius. The sphere has a heat generation term per unit volume of S, an outside radius of R, an initial temperature of T_i, and at time equal 0 and later a surface temperature of T_S. **State all BC's and the IC.**