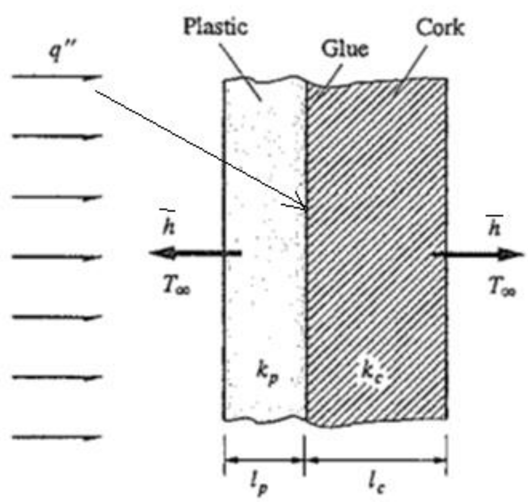
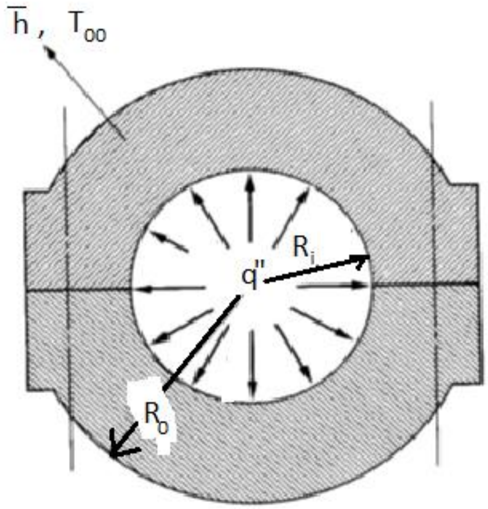
Cankaya University
Faculty of Engineering
Mechanical Engineering Department
Fall 2018
HW 4

P-1)

In a manufacturing operation, a sheet of plastic 1 cm thick is to be glued to a sheet of cork board 3 cm thick. See Fugure To affect a bond, the glue is to be maintained at a temperature of 30 °C for a considerable period of time. This is accomplished by a source of radiant heat, applied uniformly over the surface of the plastic. The exposed sides of the cork and the plastic have a heat transfer coefficient by convection of 10 $W/m^2 \cdot K$, and the room temperature during the operation is 25 °C. Estimate the rate at which heat must be supplied to the surface of the plastic to obtain the required temperature at the interface. The thermal resistance of the glue may be neglected. The thermal conductivities of plastic and of cork are 2.3 and 0.042 $W/m \cdot K$, respectively. Draw the thermal circuit for the system.

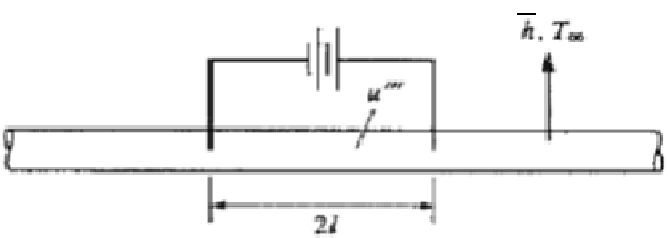


P2.) The inside surface of a bomb calorimeter is subjected to the heat flux q'' resulting from an exothermic chemical process. See Figure given below. The inner and outer radii of the calorimeter are R_i and R_0 respectively. The outside heat transfer coefficient is $\bar{h}$ and the ambient temperature is T_∞. Evaluate the inside surface temperature of the calorimeter.



P-3)

Consider an infinitely long fin. Internal energy u''' is steadily generated in a part of the fin 2ℓ long. See figure The entire fin transfers heat with a coefficient $\bar{h}$ to an ambient at temperature T_∞. **(a)** Find the temperature distribution within the fin. **(b)** Resolve the problem for a fin $2(\ell + L)$ long with insulated ends. The internal energy continues to be generated in the 2ℓ long central part of the fin.

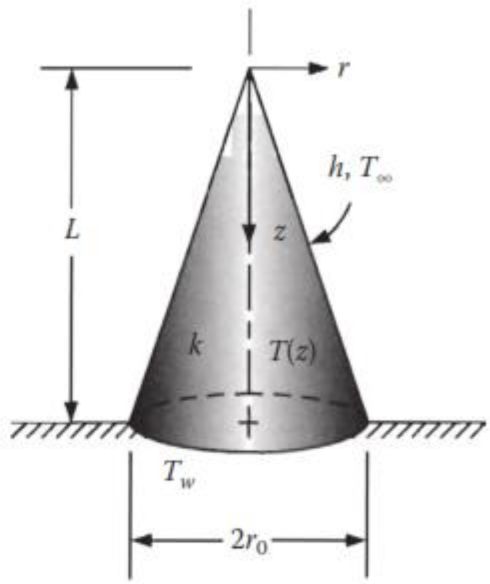


P-4)

A spine attached to a wall maintained at a uniform temperature T_w has the shape of a circular cone with base radius r_0 and height L as illustrated in Fig. 3.30, and is exposed to a fluid at a uniform temperature T_∞. Assuming constant thermal conductivity k and heat transfer coefficient h, and that the variation of the temperature in the r direction is negligible, obtain

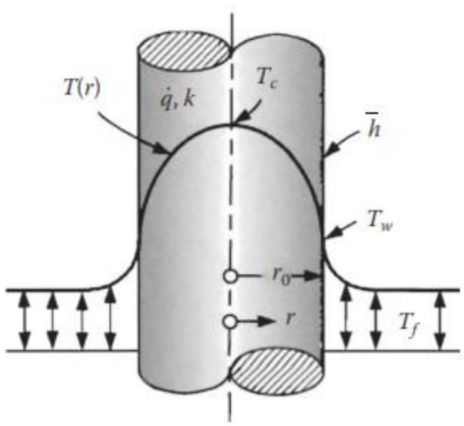
(*a*) an expression for the steady-state temperature distribution $T(z)$ in the spine, and

(*b*) an expression for the rate of heat loss from the spine to the surrounding fluid.



p-5)

Consider a long solid cylinder of radius r_0 with uniformly distributed heat sources and of constant thermal conductivity, as shown in figure This cylinder is exposed to a fluid at temperature T_f with a constant heat transfer coefficient $\bar{h}$ on the surface.



Assume that properties (ρ, c, k)are constant and cylinder is under steady state conditions.

a) Develop the governing differential equation from basic principles.
b) Write the boundary conditions
c) Obtain the temperature distribution
d) Obtain an expression for cylinder surface temperature T_w
e) Obtain an expression for cylinder center temperature