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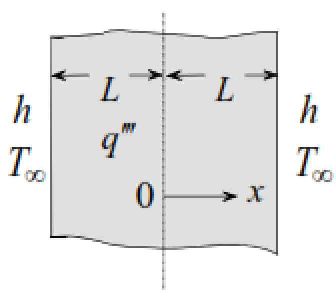
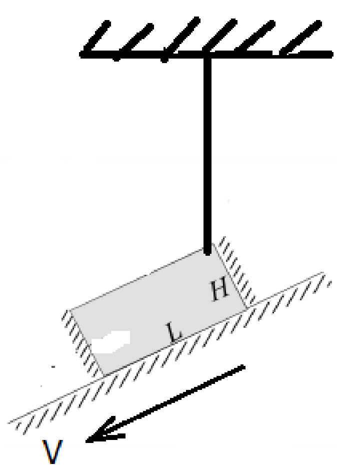
HW 3
Spring 2017

1) A plate of thickness 2L is initially at temperature Electricity is suddenly passed through the plate resulting in a volumetric heat generation rate of q''' . Simultaneously, the two sides begin to exchange heat by convection with an ambient fluid at T_∞ The thermal conductivity is k, heat



transfer coefficient h and the thermal diffusivity is $\alpha = \dfrac{k}{\rho c}$. Determine the one-dimensional transient temperature distribution.

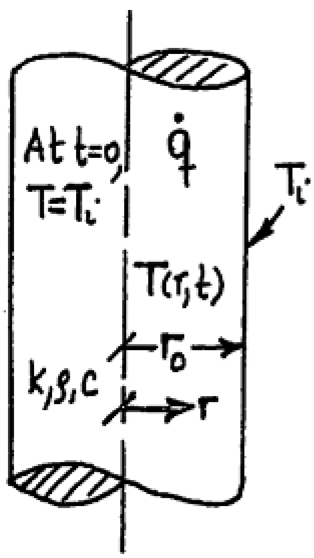
2) A bar of rectangular cross section $L \times H$ is initially at uniform temperature .The density of the bar is ρ. Bar is rigidly attached to a plane as shown. At time *t* = 0, the inclined plane starts



move with a constant velocity *V*. The pressure and coefficient of friction at the interface are p and μ, respectively. Assume a unit depth into the paper.On the opposite side the bar exchanges heat by convection with the surroundings. The heat transfer coefficient is *h* and the ambient temperature is T_∞. The two other surfaces are insulated. Assume that the Biot number is large compared to unity and neglect heat transfer in the direction normal to the plane of paper, determine the transient temperature distribution.

3) A slab of thickness L ,thermal conductivity k, density ρ and specific heat c is initially at a uniform temperature T_i .For times $t \geq 0$,the temperature of the surface at x=Lis maintained at $T = T_w$., while the other surface is at x=0 is kept perfectly insulated. Obtain the temperature distribution.

4) A long solid rod of radius r_0 and constant thermophysical properties is initially at temperature T_i . For times $t \geq 0$ internal energy is generated in the rod at a constant rate q per unit volume



While the peripheral surface at $r = r_0$ is maintained at $T = T_i$ .Obtain an expression for the unsteady –state temperature distribution T(r,t) in the cylinder for t>0.

5) A plane wall is initially at a uniform temperature T_0 with no energy generation. At time t=0 a uniform reaction within the wall begins to take place which increases to a steady value in time. The surface temperatures are maintained at T_0 .

a) construct the mathematical model as

$$kT_{xx} = g'''\left[1 - \exp(-at)\right] = \rho c T_t$$

T(x,0)= T_0 , T(L, t)=T_0 , T(0,t)= T_0

b) Determine temperature distribution T(x,t)