9. The temperature distribution $u(x, t)$ in a 2-m long brass rod is governed by the problem

$$\alpha^2 u_{xx} = u_t, \qquad\qquad (0 < x < 2, \ 0 < t < \infty)$$

$$u(0, t) = u(2, t) = 0, \qquad (t > 0)$$

$$u(x, 0) = \begin{cases} 50x, & (0 < x < 1) \\ 100 - 5x, & (1 < x < 2) \end{cases}$$

where $\alpha^2 = 2.9 \times 10^{-5}$ m^2/sec.

(a) Determine the solution for $u(x, t)$.

(b) Compute the temperature at the midpoint of the rod at the end of 1 hour.

(c) Compute the time it will take for the temperature at that point to diminish to $5°$ C.

(d) Compute the time it will take for the temperature at that point to diminish to $1°$C.

(The problem is from Separation of Variables in Diffusion Equation.)