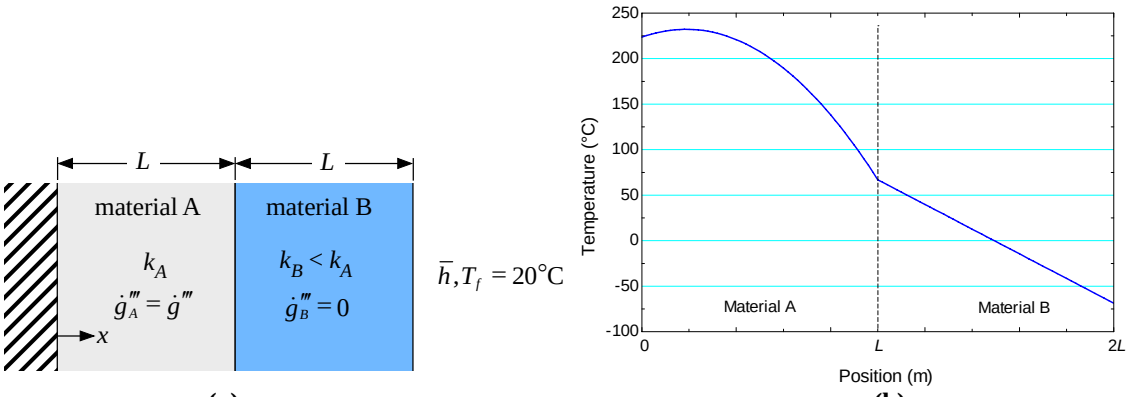
Problem 1.3-3 (1-7 in text): Critical Evaluation of a Solution

One of the engineers that you supervise has been asked to simulate the heat transfer problem shown in Figure P1.3-3(a). This is a 1-D, plane wall problem (i.e., the temperature varies only in the x-direction and the area for conduction is constant with x). Material A (from $0 < x < L$) has conductivity k_A and experiences a uniform rate of volumetric thermal energy generation, $\dot{g}'''$. The left side of material A (at $x = 0$) is completely insulated. Material B (from $L < x < 2L$) has *lower* conductivity, $k_B < k_A$. The right side of material B (at $x = 2L$) experiences convection with fluid at room temperature (20°C). Based on the facts above, critically examine the solution that has been provided to you by the engineer and is shown in Figure P1.3-3(b). There should be a few characteristics of the solution that do not agree with your knowledge of heat transfer; list as many of these characteristics as you can identify and provide a clear reason why you think the engineer's solution must be wrong.



(a) **(b)**

Figure P1.3-3: (a) Heat transfer problem and (b) "solution" provided by the engineer.

1. The left side of material A is insulated; therefore, the temperature gradient should be zero.
2. Material A has a higher conductivity than material B; therefore, at $x = L$ the temperature gradient should be larger in material B than in material A.
3. Heat is transferred to the fluid at 20°C; therefore the temperature at $x = 2L$ must be greater than 20°C.