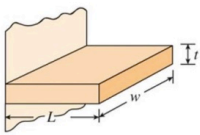
Example

A single straight brass fin with rectangular cross-section is considered to be infinitely long.

The temperature at the base of the fin is 60°C and ambient air near the fin is 30°C. The brass conducts heat at 110 W/mK and the convective heat transfer coefficient is 10 W/m²K.

Determine:

a) The temperature of the fin at 5 cm from the base of the fin.
b) The rate of heat transfer from the fin.



L = infinite
w = 10 cm
t = 1 mm

$P = 2(w + th)$

$$m = \sqrt{\frac{hP}{kA_c}} = \sqrt{\frac{10\,[W/m^2K] \times 2(0.1\,[m] + 0.001\,[m])}{110\,[W/mK]\,(0.1\,[m] \times 0.001\,[m])}} = 13.55\,[m^{-1}]$$

a. Infinitely long $\rightarrow$ $\dfrac{T(x) - T_\infty}{T_B - T_\infty} = e^{-mx}$

$$T(x) = e^{-mx}(T_B - T_\infty) + T_\infty$$

$$T(0.05m) = \exp(-13.55\,[m^{-1}] \times 0.05\,[m])\,(60°C - 30°C) + 30°C$$

$$= \boxed{45.29°C}$$

b. $\dot{Q} = \sqrt{hPkA_c}\,(T_B - T_\infty)$ ← Infinitely long

$$= \sqrt{(10\,W/m\cdot K) \times 0.202\,[m] \times 110\,[W/mK] \times 10^{-4}\,[m^2]}\,(60°C - 30°C)$$

$$= \boxed{4.97\,[W]}$$