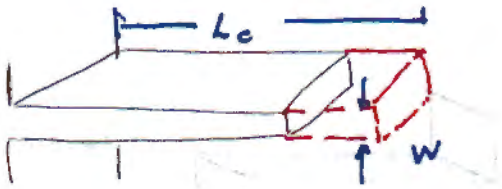
Example

(c) Repeat part b) using the fin efficiency concept.

$$\eta = \frac{\dot{Q}}{\dot{Q}_{MAX}}$$

$$\dot{Q}_{MAX} = hA_{fin}(T_b - T_\infty)$$

$$\dot{Q} = \eta \dot{Q}_{MAX}$$



$$L_c = L + A_c/p = L + \frac{t \cdot w}{2t + 2w}$$

$$= 7.65\,cm$$

$$A_{fin} = 2 \cdot L_c \cdot w + 2 \cdot L_c \cdot t$$

$$= (2)(0.0765\,m)(1\,m) + (2)(0.0765\,m)(0.003\,m)$$

$$= 0.154\,m^2$$

$$\dot{Q}_{MAX} = 10 \frac{W}{m^2 \cdot K} \cdot 0.154\,m^2 (300 - 50)\,^\circ C$$

$$= 3836\,W$$

For insulated tip BC (straight fin)

$$\eta = \frac{\tanh(mL_c)}{mL_c} \qquad m = \sqrt{\frac{hp}{kA_c}} = 5.782\,m^{-1}$$

$$= \frac{\tanh(5.782\,m^{-1} \cdot 0.0765\,m)}{5.782\,m^{-1} \cdot 0.0765\,m}$$

$$= 0.9395$$

$$\dot{Q} = (0.9395)(383.6\ W)$$

$$= 360\ W$$

Use charts to find η instead

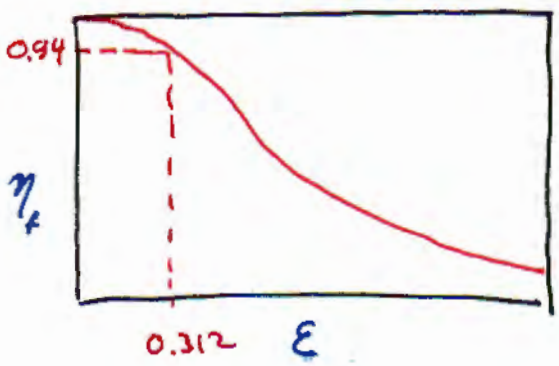
$$\varepsilon = L_c^{3/2}\left(\frac{h}{kA_p}\right)^{1/2} \qquad A_p = L_c \cdot t$$

$$= (0.0765)m \cdot (0.003)m$$

$$= 0.0002295\ m^2$$

$$= 0.0765^{3/2}\ m^{3/2}\left[\frac{10\ \frac{W}{m^2 \cdot K}}{200\ \frac{W}{m \cdot K} \cdot 0.0002295\ m^2}\right]^{1/2}$$

$$= 0.312$$



From chart

$$\eta_f \approx 0.94$$

$$\dot{Q} = (0.94)(383.6\ W)$$

$$= 361\ W$$