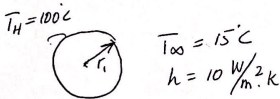
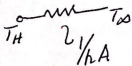


1- The wall of a pipe carrying steam has a temperature of $T_H = 100^\circ\text{C}$, and an outer radius of $r_1 = 4\text{ cm}$. The pipe is exposed to ambient air at $T_\infty = 15^\circ\text{C}$, with an average heat transfer coefficient $h = 10\text{ W/m}^2\text{K}$. You would like to wrap a 1-cm thick layer of polystyrene insulation around the base steam pipe. Will the heat transfer rate from the steam to the atmosphere decrease if you install the polystyrene insulation? To verify your answer, calculate the heat loss when the pipe wall is bare, and when it is covered by the polystyrene layer. Assume the same h value in both cases.



Bare



$$R_{\text{conv}} = \frac{1}{h(2\pi r_1)L}$$

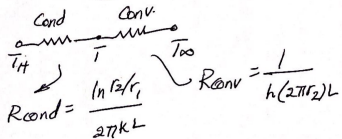
$$= \frac{1}{10(2\pi \times 0.04)(1\text{m})}$$

$$= 0.398\text{ K/W}$$

$$q_{\text{bare}} = \frac{T_H - T_\infty}{R_{\text{conv}}}$$

$$= \frac{100 - 15}{0.398}$$

$$= 213.6\text{ W}$$



$$R_{\text{cond}} = \frac{\ln 5/4}{2\pi(0.027) \times 1}$$

v From table

$$= 1.315\text{ K/W}$$

$$R_{\text{conv}} = \frac{1}{10(2\pi)(0.05) \times 1}$$

$$= 0.318\text{ K/W}$$

$$q_{\text{with ins}} = \frac{(100 - 15)}{1.315 + 0.318} = 52.1\text{ W}$$