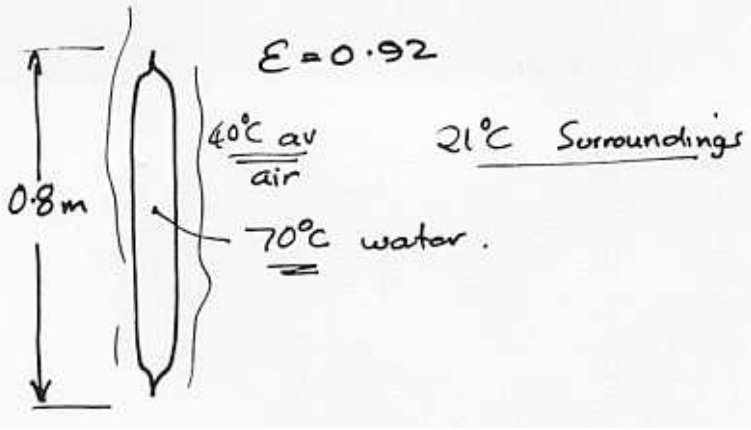


Heat is dissipated by radiation & convection

(a) Radiation $\dot{Q}_{rad} = \varepsilon \sigma A (T_s^4 - T_a^4)$

$= 0.92 \times 5.67 \times 10^{-8} \times 0.8 \times 1 \left((273+70)^4 - (273+21)^4\right)$

$= 266$ Watts / side

$= \underline{532 \text{ W/m}}$.

(b) Convection

$$Gr = \frac{\beta g \rho^2 l^3 \Delta T}{\mu^2}$$

with $\beta = \frac{1}{T}$ $Gr = \dfrac{g \rho^2 l^3 \Delta T}{T \mu^2}$

At 40°C $\rho = \frac{273}{273+40} \times \frac{1}{0.773} = 1.128$ kg/m$^3$ $\beta = \frac{1}{273+40}$

$\mu = 0.019 \times 10^{-3}$ kg/sm & $\lambda = 0.0272$ W/mK

$$\therefore Gr = \frac{9.81 \times 1.128^2 \times 0.8^3 (70-21)}{(273+40)(0.019 \times 10^{-3})^2} = \underline{2771 \times 10^6}$$

$$\therefore Nu = 0.378 (2771 \times 10^6)^{0.25} = 86.7$$

$$h = \frac{\lambda Nu}{L} = \frac{0.0272 \times 86.7}{0.8} = 2.95 \text{ W/m}^2\text{K}$$

$$\dot{Q}_{conv.} = h A \Delta T = 2.95 \times 0.8 \times 1 \times 2 (70-21) = \underline{231 \text{ W/m}}$$

Total $\dot{Q}/m = 532 + 231 = 763$ W/m

$\therefore$ Length for 1000 W $= \frac{1000}{763} = \underline{1.31 \text{ m}}$