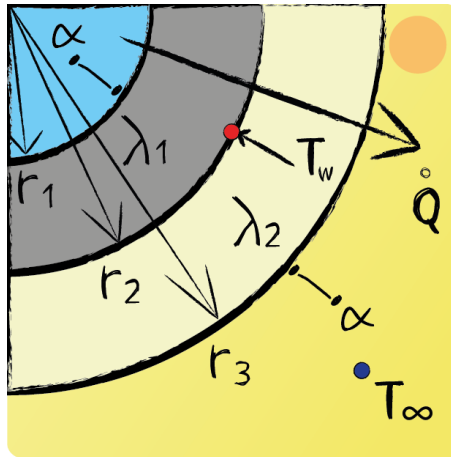# Lecture 8 Question 3

Water is flowing through a multi-layer pipe with length L. Assume steady-state, one-dimensional heat transfer.

Give an expression for the temperature T_w

Rate of heat transfer through a multi-layer pipe wall with convection:

$$\dot{Q} = \frac{2 \cdot \pi \cdot L \cdot (T_\mathrm{A} - T_\mathrm{B})}{\frac{1}{\alpha_A \cdot r_1} + \sum_{i=1}^{n} \frac{1}{\lambda_\mathrm{i}} \cdot \ln \frac{r_\mathrm{i+1}}{r_\mathrm{i}} + \frac{1}{\alpha_B \cdot r_\mathrm{n+1}}}$$

Between T_w and T_∞ we have 1 solid layer and convection is taking place at the outside.

And thus:

$$\dot{Q} = \frac{2 \cdot \pi \cdot L \cdot (T_\mathrm{w} - T_\infty)}{\frac{1}{\lambda_2} \cdot \ln \frac{r_3}{r_2} + \frac{1}{\alpha \cdot r_3}}$$

Rewriting:

$$T_\mathrm{w} = \dot{Q} \cdot \frac{\frac{1}{\lambda_2} \cdot \ln \frac{r_3}{r_2} + \frac{1}{\alpha \cdot r_3}}{2 \cdot \pi \cdot L} + T_\infty$$