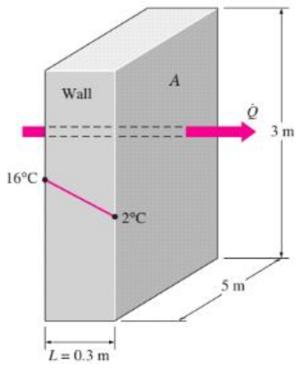
Find the rate of heat trasfer through the wall if k=0.9 W/m C



$$\dot{Q} = \frac{K \times A}{L} \times \Delta T = 0.9 * 15 * \frac{16 - 2}{0.3}$$
$$= 630\ W$$

=

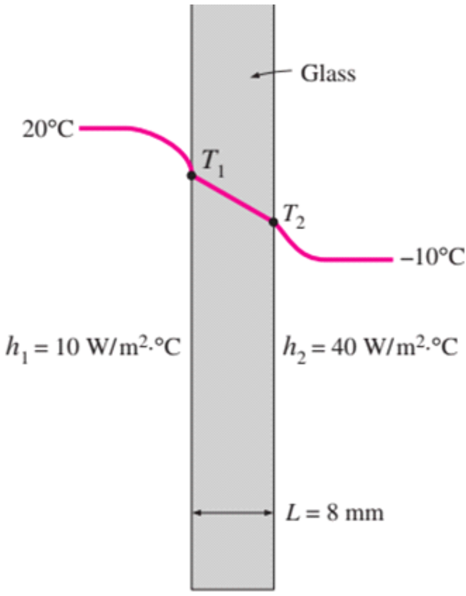
Let's use the equivalent network !

$$\mathrm{R_{wall}} = \frac{\mathrm{L}}{\mathrm{K \times A}} = \frac{0.3}{0.9 * 15} = 0.0222$$

$$\dot{Q} = \frac{\Delta T}{\mathrm{R_{wall}}} = \frac{14}{0.0222} = 630\ \mathrm{W}$$

Example A: Heat loss through a single pane window

Consider a 0.8 m high and 1.5 m wide glass window, shown above with a thermal conductivity of k =0.78 W/m·°C. Determine the steady rate of heat transfer through this glass window and the temperature of its inner surface



$$\Delta T = 20 - (-10) = 30\ C$$

$$R_{glass} = \frac{L}{k \times A} = \frac{0.008}{0.78 * 0.8 * 1.5} = 0.0085 \frac{C}{W}$$

$$R_1 = \frac{1}{h_1 \times A} = \frac{1}{10 * 0.8 * 1.5} = 0.0833\ C/W$$

$$R_2 = \frac{1}{h_2 \times A} = \frac{1}{40 * 0.8 * 1.5} = 0.0208\ C/W$$

$$R_{tot} = R_1 + R_{glass} + R_2 = 0.0085 + 0.0833 + 0.0208 = 0.1126\ C/W$$

$$\dot{\mathrm{Q}} = \frac{(\Delta \mathrm{T})}{\mathrm{R_{tot}}} = \frac{30}{0.1126} = 266.4\ \mathrm{W}$$

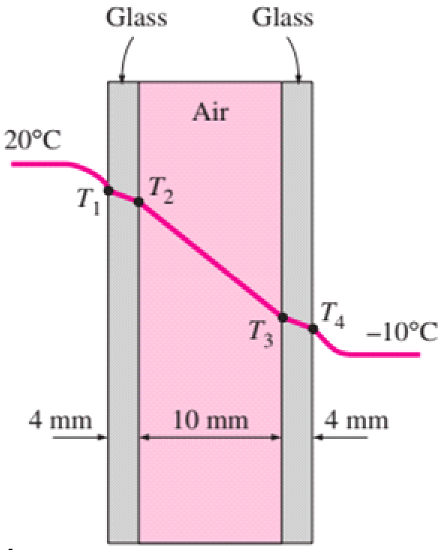
$$\dot{\mathrm{Q}} = \frac{\mathrm{T_{inff1}} - \mathrm{T_{s_1}}}{\mathrm{R_1}} \rightarrow \mathrm{T_{s_1}} = \mathrm{T_{inff1}} - \dot{\mathrm{Q}} * \mathrm{R_1} = -2.2\ \mathrm{C}$$

Example B: Heat loss through a double pane window

Consider a 0.8-m-high and 1.5-m-wide double-pane window consisting of two 4-mm-thick layers of glass (k= 0.78 W/m.°C) separated by a 10-mm-wide stagnant air space (k= 0.026 W/m.°C). Determine the steady rate of heat transfer through this double-pane window and the temperature of its inner surface.

Take the convection heat transfer coefficients on the inner and outer surfaces of the window to be h1= 10 W/m2 · °C and h2=40 W/m2 · °C, which includes the effects of radiation.

$$\Delta T = 20 - (-10) = 30\ C$$



$$R_{g1} = R_{g_2} = \frac{L_g}{k_g \times A} = \frac{0.004}{0.78 * 0.8 * 1.5} = 0.0043\frac{C}{W}$$

$$R_1 = \frac{1}{h_1 \times A} = \frac{1}{10 * 0.8 * 1.5} = 0.0833\ C/W$$

$$R_2 = \frac{1}{h_2 \times A} = \frac{1}{40 * 0.8 * 1.5} = 0.0208\ C/W$$

$$R_{gap} = \frac{L_{gap}}{k_{gap} \times A} = \frac{0.01}{0.026 * 1.2} = 0.3205\ C/W$$

$$R_{tot} = R_1 + 2 \times R_{glass} + R_{Gap} + R_2$$

$$= 0.0833 + 0.0208 + 2 * 0.0043 + 0.3205 = \frac{0.4332C}{W}$$

$$\dot{\mathrm{Q}} = \frac{(\Delta \mathrm{T})}{\mathrm{R_{tot}}} = \frac{30}{0.4332} = 69.2\ \mathrm{W}$$

$$\dot{\mathrm{Q}} = \frac{\mathrm{T_{inff1}} - \mathrm{T_{s_1}}}{\mathrm{R_1}} \rightarrow \mathrm{T_{s_1}} = \mathrm{T_{inff1}} - \dot{\mathrm{Q}} * \mathrm{R_1} = 14.2\ \mathrm{C}$$