A bar of gold is in thermal contact with a bar of silver of the same length and area as shown. One end of the compound bar is maintained at 80.0°C while the opposite end is at 30.0°C. When the energy transfer reaches steady state, what is the temperature at the junction?

**P20.43**

In the steady state condition, 
\[ P_{Au} = P_{Ag} \]
so that
\[ k_{Au} A_{Au} \frac{\Delta T}{\Delta x} = k_{Ag} A_{Ag} \frac{\Delta T}{\Delta x} \]
In this case \[ A_{Au} = A_{Ag} \]
\[ \Delta x_{Au} = \Delta x_{Ag} \]
\[ \Delta T_{Au} = (80.0 - T) \]
and \[ \Delta T_{Ag} = (T - 30.0) \]
where \( T \) is the temperature of the junction.
Therefore, \[ k_{Au} (80.0 - T) = k_{Ag} (T - 30.0) \]
And \( T = 51.2°C \)

Radiant heat makes it impossible to stand close to a hot lava flow. Calculate the rate of heat loss by radiation from 1.00 m² of 1200°C fresh lava into 30.0°C surroundings, assuming lava’s emissivity is 1.

Let the system be the lava. Take the temperature of the lava to be \( T_1 = 1200°C = 1473.15 \). Since the \( Q_{lava} \) is leaving the system, it is negative. Take the temperature of the surroundings to be \( T_2 = 30°C = 303.15 \). Since the \( Q_{surr} \) is entering the system, it is positive. The total power flowing in and out of the lava is:

\[ P = Q_{surr} - Q_{lava} = e\sigma A T_2^4 - e\sigma A T_1^4 \]
\[ = e\sigma A (T_2^4 - T_1^4) \]
\[ = 1(5.67 \times 10^{-8} J / smK^4) 1m^2((303.15K)^4 - (1473.15K)^4) \]
\[ = -266kW \]