Heat Transfer

Consider a two-layer problem where one layer has twice the thickness and six times the thermal conductivity as the other layer, but the layers have the same area.

Show how you find the temperature at the interface between the layers, if the temperature on the left face of the thicker layer is 24°C, and the temperature on the right face of the thin layer is 0°C.

\[ T = 24 \quad T = ? \quad T = 0 \]
Newton’s law of cooling states that the rate at which an object cools is proportional to the temperature difference between the object and the surrounding environment. This leads to an exponential relationship between the object’s temperature, as a function of time, as it cools:

\[ T_{\text{object}} = T_{\text{environment}} + (T_{\text{initial}} - T_{\text{environment}})e^{-\lambda t} \]

\(T_{\text{initial}}\) is the initial temperature of the object, \(T_{\text{object}}\) is the object’s temperature at a time \(t\) after the cooling process begins, and \(\lambda\) is a constant that is related to the decay rate of the temperature.

Let’s say that \(T_{\text{environment}} = 20°C\), and \(T_{\text{initial}} = 80°C\). Based on Newton’s law of cooling, which of these statements is true?

[   ] It takes twice as long for the object to cool from 80°C to 40°C as it does for the object to cool from 80°C to 60°C

[   ] It takes more than twice as long for the object to cool from 80°C to 40°C as it does for the object to cool from 80°C to 60°C

[   ] It takes less than twice as long for the object to cool from 80°C to 40°C as it does for the object to cool from 80°C to 60°C

Using Newton’s law of cooling, determine the ratio of the two times in the preceding question.