Example. A turkey at 60 F is placed in a 350 degree oven. After 3 hours, the temperature of the turkey is found to be 135 F. The turkey is considered fully cooked when its temperature is 165 F. Assuming the turkey cooks uniformly and behaves according to Newton’s law of cooling, how much longer will it take before the turkey is ready to eat?

Set \( t = \text{time (hr)} \)

\[ T(t) = \text{temp. of the turkey (F)} \]

\( T_{\text{oven}} = \text{temp. of the oven} = 350 \text{ F} \)

Assume Newton’s law of cooling

\[ T' = -k(T - T_{\text{oven}}), \quad k > 0 \]

**Soll.** \( T_{\text{oven}} = 350 \)

\[ T(t) = T_{\text{oven}} + Ce^{-kt} \]

**IC.** \( T(0) = 60 = 350 + C \Rightarrow C = -290 \)

\[ T(t) = 350 - 290e^{-kt} \]
Have \( Q(t) = 155 = 350 - 290 e^{-\frac{t}{k}} \)

\[ \Rightarrow 155 = 350 - 290 e^{-\frac{3}{k}} \]

\[ 290 e^{-\frac{3}{k}} = 215 \]

\[ -\frac{3}{k} = \ln \left( \frac{215}{290} \right) \]

\[ k = -\frac{1}{3} \ln \left( \frac{215}{290} \right) = 0.997 \frac{1}{hr} \]

Set \( t_{exit} \) to be \( T(t_{exit}) = 165 \)

\[ \Rightarrow 165 = 350 - 290 e^{-\frac{t_{exit}}{k}} \]

\[ 290 e^{-\frac{t_{exit}}{k}} = 185 \]

Solve \( t_{exit} = -\frac{1}{k} \ln \left( \frac{185}{290} \right) \approx 4.5 \text{ hr.} \)