

Question 3

A cup of coffee is initially at 190°F and is left to cool in a room that is maintained at 70°F. After 15 minutes, the coffee has cooled to 130°F.

Assume the temperature of the coffee follows Newton's Law of Cooling:

$$T(t) = T_{\text{room}} + (T_0 - T_{\text{room}})e^{-kt}$$

- (a) Find the value of the constant k .
- (b) What will the temperature be after 30 minutes?
- (c) After how many minutes will the coffee reach 100°F?

Round all answers to two decimal places.

Question 3 - Solution

Use the exact exponential model and keep full precision until the final rounding.

(a)

$$130 = 70 + 120e^{-15k} \implies k = \ln(2)/15$$

$$\boxed{0.05 \text{ min}^{-1}}$$

The exact value of k above is used in later parts; its decimal value is 0.046210.

(b)

$$T(30) = 70 + 120e^{-2 \ln 2}$$

$$\boxed{100.00 \text{ }^{\circ}\text{F}}$$

(c)

$$100 = 70 + 120e^{-kt} \implies t = \ln(4)/k$$

$$\boxed{30.00 \text{ minutes}}$$