

Instructions: Show all work. Use exact answers unless otherwise asked to round.

1. A coffee cup is removed from a microwave with a temperature of 210° . The room temperature is 75° . After a minute, the temperature of the liquid in the mug is 190° . Write a differential equation that models the temperature of the liquid in the mug. And then determine the amount of time that will be needed for the temperature in the liquid to drop to 130° .

$$\frac{dT}{dt} = k(T - u_0)$$

$$T(0) = 210$$

$$u_0 = 75^\circ$$

$$T(1) = 190^\circ$$

$$\frac{dT}{T-75} = k dt \Rightarrow \ln|T-75| = kt + C \Rightarrow T-75 = e^{kt+C} = T_0 e^{kt}$$

$$T(t) = 75 + T_0 e^{kt}$$

$$210 = 75 + T_0 e^{k \cdot 1}$$

$$T_0 = 135$$

$$T(t) = 75 + 135 e^{kt}$$

$$190 = 75 + 135 e^{k(1)}$$

$$\frac{23}{27} = e^k \Rightarrow k = \ln\left(\frac{23}{27}\right) = -0.160343$$

$$T(t) = 75 + 135 e^{-0.160343t}$$

$$130 = 75 + 135 e^{-0.160343t}$$

$$t = 5.6 \text{ minutes}$$