

## Section 4.2 Question 3

3. At 12:00 PM a thermometer reading  $10^\circ\text{F}$  is placed in a room where the temperature is  $70^\circ\text{F}$ . It reads  $56^\circ$  when it's placed outside, where the temperature is  $5^\circ\text{F}$ , at 12:03. What does it read at 12:05 PM?

Here  $T_0 = 10^\circ\text{F}$  and  $T_m = 70^\circ\text{F}$

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$$T = T_m + (T_0 - T_m)e^{-kt}$$

$$T = 70 + (10 - 70)e^{-kt}$$

$$T = 70 - 60e^{-kt}$$

determining  $k$  with 3 minutes after and  $56^\circ\text{F}$

$$T(3) = 56$$

$$56 = 70 - 60e^{-k(3)}$$

$$56 - 70 = -60e^{-3k}$$

$$\frac{-14}{-60} = \frac{-60e^{-3k}}{-60}$$

$$\frac{14}{60} = e^{-3k} \rightarrow e^{-3k} = \frac{7}{30}$$

$$\ln(e^{-3k}) = \ln\left(\frac{7}{30}\right) \rightarrow \frac{-3k}{-3} = \frac{\ln\left(\frac{7}{30}\right)}{-3}$$

$$k = \frac{1}{3} \ln\left(\frac{30}{7}\right)$$

the temperature after 2 minutes with  $T_0 = 56^\circ\text{F}$ ,  $T_m = 5^\circ\text{F}$

$$T(2) = 5 + (56 - 5)e^{-\frac{2}{3} \ln\left(\frac{30}{7}\right)}$$

$$T(2) = 5 + 51\left(\frac{30}{7}\right)^{-\frac{2}{3}}$$

$$T = 5 + 51\left(\frac{7}{30}\right)^{\frac{2}{3}} \approx \boxed{24.33^\circ\text{F}}$$