

AP CALCULUS AB

- 1) A metal block is taken out of a freezer at 15 °F and is put in a 70 °F room. After five minutes the temperature of the block is 40 °F. How long after the block is taken out of the freezer will its temperature be 65 °F?

$$T = T_{\infty} + (T_0 - T_{\infty})e^{-kt}$$

$$T = 70 + (15 - 70)e^{-kt}$$

$$T = 70 - 55e^{-kt}$$

$$40 = 70 - 55e^{-k \cdot 5}$$

$$-30 = -55e^{-5k}$$

$$e^{-5k} = \frac{30}{55}, \quad -5k = \ln\left(\frac{30}{55}\right),$$

$$k = -\frac{1}{5} \ln\left(\frac{30}{55}\right) = 0.121 / \text{min}$$

$$65 = 70 - 55e^{-kt}$$

$$-5 = -55e^{-kt}$$

$$e^{-kt} = \frac{5}{55}, \quad -kt = \ln\left(\frac{5}{55}\right)$$

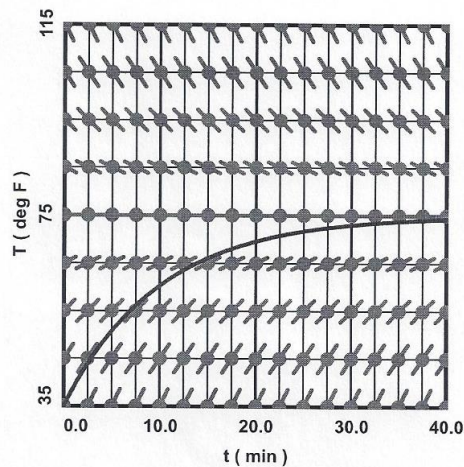
$$t = -\frac{1}{k} \ln\left(\frac{5}{55}\right) = 19.78 \text{ min} = 19:47$$

NEWTON'S LAW OF COOLING

- 2) A cup of water is taken out of a refrigerator at 35 °F and is put into a 75 °F room. The slope field for this situation is

$$\frac{dT}{dt} = -\frac{1}{10}(T - 75^\circ), \quad \Rightarrow k = -0.1$$

which slope field is graphed on the grid.



On the grid, graph $T = T(t)$ of the water. —

$$T = T_{\infty} + (T_0 - T_{\infty})e^{-kt}$$

$$T = 75 + (35 - 75)e^{-0.1t}$$

$$T = 75 - 40e^{-0.1t}$$