

10. Newton's law of cooling states that the rate at which an object cools is proportional to the difference in temperature between the object and the surrounding medium. Thus, if an object is taken from an oven at 400°F and left to cool in a room at 60°F , then its temperature T after t hours will satisfy the differential equation

$$\frac{dT}{dt} = k(T - 60).$$

If the temperature fell to 300°F after one hour, what will it be after 4 hours? (You may leave "ln" in your answer.)

$$\int \frac{dT}{T-60} = \int k dt$$

$$\ln|T-60| = kt + C$$

$$|T-60| = e^{\ln|T-60|} = e^{kt+C}$$

$$T-60 = \pm e^C e^{kt}$$

$$\text{Let } K = \pm e^C$$

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

$$T(0) = 400$$

$$400 - 60 = K e^{k \cdot 0}$$

$$340 = K$$

$$T(1) = 300$$

$$300 - 60 = 340 e^{k}$$

$$\frac{240}{340} = e^k$$

$$\ln\left(\frac{24}{34}\right) = k$$

$$T(4) = 60 + 340 e^{\ln\left(\frac{24}{34}\right)4} \quad ^\circ\text{F}$$

P.S. Don't eat this cake. It must be made out of some insulating material! After 4 hours its temperature is still 144.