Name: _____ Date: _____

Learning Goal 3.7	Creating confidence in word problems.

More Questions – Solutions

1. A bottle of soda pop at room temperature $(72°\text{F})$ is placed in a refrigerator where the temperature is $44°\text{F}$. After half an hour the soda pop has cooled to $61°\text{F}$.

$$61 = 72e^{r(30)}$$
$$\frac{61}{72} = e^{30r}$$
$$\ln\left(\frac{61}{72}\right) = 30r$$
$$r = \frac{1}{30}\ln\left(\frac{61}{72}\right)$$

$$T_F = 72e^{{}^1/_{30}\ln({}^{61}/_{72})t}$$
$$= 72\left(e^{\ln({}^{61}/_{72})}\right)^{{}^1/_{30}t}$$
$$= 72\left(\frac{61}{72}\right)^{{}^t/_{30}}$$

   a. What is the temperature of the soda pop after another half hour?

$$T_F = 72\left(\frac{61}{72}\right)^{{}^{60}/_{30}}$$
$$= 72\left(\frac{61}{72}\right)^2$$
$$= \frac{61^2}{72}$$
$$\approx 52°\text{F}$$

   b. How long does it take for the soda pop to cool to $50°\text{F}$?

$$50 = 72\left(\frac{61}{72}\right)^{{}^t/_{30}}$$
$$\frac{50}{72} = \left(\frac{61}{72}\right)^{{}^t/_{30}}$$
$$\ln\left(\frac{50}{72}\right) = \ln\left(\frac{61}{72}\right)^{{}^t/_{30}}$$
$$\ln\left(\frac{50}{72}\right) = \frac{t}{30}\ln\left(\frac{61}{72}\right)$$
$$\frac{t}{30} = \frac{\ln\left(\frac{50}{72}\right)}{\ln\left(\frac{61}{72}\right)}$$
$$t = 30\frac{\ln\left(\frac{50}{72}\right)}{\ln\left(\frac{61}{72}\right)} \approx 66 \text{ minutes}$$

2. How long will it take an investment to double in value if the interest rate is 6% compounded continuously? What is the equivalent annual interest rate, compounded monthly?

$$A = A_0 e^{rt}$$
$$\frac{A}{A_0} = e^{0.06t}$$
$$2 = e^{0.06t}$$
$$\ln 2 = \ln(e^{0.06t})$$
$$\ln 2 = 0.06t$$
$$t = \frac{\ln 2}{0.06}$$

$$A = A_0\left(1 + \frac{r}{n}\right)^{nt}$$
$$2 = \left(1 + \frac{r}{12}\right)^{12\left(\ln 2/0.06\right)}$$
$$\ln(2) = \ln\left(1 + \frac{r}{12}\right)^{12\left(\ln 2/0.06\right)}$$
$$\ln(2) = 12\left(\frac{\ln 2}{0.06}\right)\ln\left(1 + \frac{r}{12}\right)$$
$$1 = 12\left(\frac{1}{0.06}\right)\ln\left(1 + \frac{r}{12}\right)$$
$$\frac{1}{200} = \ln\left(1 + \frac{r}{12}\right)$$
$$e^{1/200} = 1 + \frac{r}{12}$$
$$r = 12(e^{1/200} - 1)$$

3. A freshly brewed cup of coffee has temperature of $95°C$ in a $20°C$ room. When its temperature is $70°C$, it is cooling at a rate of $1°C$ per minute. When does this occur?

$$70 = 95\, e^{-t}$$
$$\frac{70}{95} = e^{-t}$$
$$\ln\left(\frac{70}{95}\right) = -t$$
$$\ln\left(\frac{95}{70}\right) = t$$
$$t = \ln\left(\frac{19}{14}\right)$$