5.8/5.9 Practice #2 **Advanced Pre-Calculus**

1. 750 grams of a certain radioactive material decays to 500 grams in 3 days. Find how long it would take to become 300 grams.

$\frac{500}{750} = \frac{750e^{k\cdot 3}}{750}$

$\frac{2}{3} = e^{3k}$

$\ln\frac{2}{3} = 3k$

$\frac{\ln\frac{2}{3}}{3} = \frac{3k}{3}$

$k \approx -.1352\ldots$

$\frac{300}{750} = \frac{750e^{-.1352t}}{750}$

$\frac{2}{5} = e^{-.1352t}$

$\frac{\ln\frac{2}{5}}{k} = \frac{-.1352t}{k}$

$t \approx 6.78$ days

2. A culture of 35 bacteria increases to 45 bacteria in 3 hours. How long would it take to become 110 bacteria?

$\frac{45}{35} = \frac{35e^{k\cdot 3}}{35}$

$\frac{9}{7} = e^{3k}$

$\ln\frac{9}{7} = 3k$

$k = .0838\ldots$

$\frac{110}{35} = \frac{35e^{.0838t}}{35}$

$\frac{110}{35} = e^{.0838t}$

$\frac{\ln\frac{110}{35}}{k} = \frac{.0838t}{k}$

$t \approx 13.67$ hours

3. A lasagna is removed from an oven when its temperature is 450°F in a room with a constant temperature of 70 °F. It takes 8 minutes for it to reach 400 °F. How long will it take for the lasgna to cool down to 175 °F?

$400 = 70 + (450-70)e^{k\cdot 8}$

$330 = 380e^{8k}$

$\frac{33}{38} = e^{8k}$

$\ln\frac{33}{38} = 8k$

$k = -.0176\ldots$

$175 = 70 + 380e^{-.0176t}$

$105 = 380e^{-.0176t}$

$\frac{105}{380} = e^{-.0176t}$

$\ln\frac{105}{380} = -.0176t$

$t \approx 72.94$ minutes

4. The following data represent crime rate against individuals (crimes per 1000 households) and their income (in dollars) in the United States in 2007.

Income	Crime Rate
5000	213.1
11,250	201.3
20,000	167.0
30,000	154.6
52,500	151.2
62,500	144.6

a. Use the graphing calculator to make a scatter plot of the data and sketch it here.

b. Using a graphing utility, build a logarithmic model from the data.

$y = 459.334 - 28.751 \ln x$

c. Use your model to predict the crime rate of a household whose income is $55,000.

$y = 459.334 - 28.751 \ln 55000$

$y = 145.5$ per 1000 households

5. The logistic mode $W(t)=\frac{14,656,248}{1+0.059e^{0.057t}}$ represents the number of farm workers in the United States t years after 1910.

a. How many workers were there initially? Round to the nearest person.

$W(0)=\frac{14656248}{1+.059e^{.057(0)}}=\frac{14656248}{1+.059}\approx 13,839,705$ in 1910

b. What is the limiting size for the number of farm workers in the United States?

14,656,248

c. How many farm workers were there in the United States in 2010?

$t=100$ $\quad W(100)=\frac{14656248}{1+.059e^{.057(100)}}\approx 786,567$

d. When ~~did~~ will the number of farm workers in the United States reach 10,000?

$\frac{10000}{1}=\frac{14656248}{1+.059e^{.057t}}$

$10000(1+.059e^{.057t})=14656248$

$10000+590e^{.057t}=14656248$

$-10000 \quad -10000$

$\frac{590e^{.057t}}{590}=\frac{14646248}{590}$

$\frac{\ln\frac{14646248}{590}}{.057}=\frac{.057t}{.057}$

$t\approx 177$ years

$+1910$

2087