2. In 1910, the population of a city was 120,000. Since then, the population has increased by 1.5% per year. If the population continues to grow at this rate, what will the population be in 2010?

$y = a(1+r)^t$

$y = 120,000(1+.015)^{100}$

$y = 531,845$ people

3. A store is offering a clearance sale on a certain type of digital camera. The original price for the camera was $198. The price decreases 10% each week until all of the cameras are sold. How many weeks will it take for the price of the cameras to drop below half of the original price?

$y = a(1-r)^t$

$\frac{99}{198} = \frac{198(1-.1)^t}{198}$

$.5 = .9^t$

or

$\ln .5 = \ln .9^t$

$\frac{\ln .5}{\ln .9} = \frac{t \ln .9}{\ln .9}$

$\log .5 = \log .9^t$

$\frac{\log .5}{\log .9} = \frac{t \log .9}{\log .9}$

$t = 6.58$ weeks

7 weeks

4. Home values in Millersport increase about 4% per year. Mr. Thomas purchased his home eight years ago for $122,000. What is the value of his home now?

$$y = a(1+r)^t$$

$$y = 122{,}000(1+.04)^8$$

$$y = \$166{,}965.42$$

A GPS system was purchased for $12,500. After 5 years, the GPS is now worth $8600. To the nearest tenth, what was the rate of depreciation?

$$y = a(1-r)^t$$

$$\frac{8600}{12{,}500} = \frac{12{,}500(1-r)^5}{12{,}500}$$

$$\sqrt[5]{.688} = \sqrt[5]{(1-r)^5}$$

$$\sqrt[5]{.688} = 1 - r$$

$$\frac{\sqrt[5]{.688} - 1}{-1} = \frac{-r}{-1}$$

$$-\sqrt[5]{.688} + 1 = r$$

$$.0721 \approx r$$

7.2%

Another model for exponential decay is $y=ae^{-kt}$, where k is a constant. This is the model preferred by scientists. Use this model to solve problems involving radioactive decay. Radioactive decay is the decrease in the intensity of a radioactive material over time, such as carbon dating methods.

The half-life of a radioactive substance is the time it takes for half of the atoms of the substance to disintegrate. All life on Earth contains Carbon-14, which decays continuously at a fixed rate. The half-life of Carbon-14 is 5760 years. The value of k for Carbon-14 is $\approx$ $\underline{.00012}$

5. A specimen that originally contained 275 milligrams of Carbon-14 is found after 12,560 years. How much Carbon-14 is remaining?

$y=ae^{-kt}$

$y=275e^{(-.00012(12,560))}$

$y=60.92$ mg

6. A specimen that originally contained 150 milligrams of Carbon-14 now contains 130 milligrams. How old is the fossil?

$$\frac{130}{150} = \frac{150e^{-.00012t}}{150}$$

$$\frac{130}{150} = e^{-.00012t}$$

$$\ln\left(\frac{130}{150}\right) = \ln e^{-.00012t}$$

$$\frac{\ln \frac{130}{150}}{-.00012} = \frac{-.00012t}{-.00012}$$

$$1192.5_{yrs} \approx t$$

7. In 2005, China's population was 1.31 billion people. It's growth can be modeled by the equation $y = 1.31e^{0.0038t}$. How long will it be before China's population reaches 2 billion people?

$$2 = 1.31e^{.0038t}$$

$$\frac{2}{1.31} = e^{.0038t}$$

$$\ln\left(\frac{2}{1.31}\right) = \ln e^{.0038t}$$

$$\frac{\ln\left(\frac{2}{1.31}\right)}{.0038} = \frac{.0038t}{.0038}$$

$$111.35 \text{ yrs} \approx t$$

112 yrs