

## Precalculus Unit 4: 4.5 Notes

### Exponential and Logarithmic Models

Exponential Growth Model:

Exponential Decay Model:

Gaussian Model:

Logistic Growth Model:

Logarithmic Models:

Examples:

1. You have an initial investment of \$20,000, with interest compounded continuously at 4.5%. How much will you have after 10 years? How long will it take your money to double?

2. You have an initial investment of \$500. After 10 years, you have \$1292.85. What interest rate were you earning if interest was compounded continuously? How long will it take your money to double?

3. Suppose at the start of an experiment there are 8000 bacteria. A growth inhibitor and a lethal pathogen are introduced into the colony. After two hours 1000 bacteria are dead. If the death rates are exponential:

How long will it take for the population to drop below 5000?

How long will it take for two-thirds of the bacteria to die?

- Radioactive iodine is a by-product of some types of nuclear reactors. Its half-life is 60 days. That is, after 60 days, a given amount of radioactive iodine will have decayed to half the original amount. Suppose a nuclear accident occurs and releases 20 grams of radioactive iodine. How long will it take for the radioactive iodine to decay to a level of 1 gram?
- A fossilized leaf contains 70% of its normal amount of carbon 14. If the half-life of carbon 14 is 5600 years, how old is the fossil?
- The population of Australia was 19.2 million in 2000 and its projected population in 2010 is 20.9 million. Find an exponential growth or decay model for the population of Australia using  $t = 0$  to represent the year 2000. Use the model to predict the population of Australia in 2030.

7. A sport utility vehicle that cost \$32,000 new has a book value of \$18,000 after 2 years. Find a linear model to represent the value of the SUV. Find an exponential model to represent the value of the SUV. Look at the graphs and compare the depreciation patterns.

8. A conservation organization releases 100 animals of an endangered species into a game preserve. The organization believes that the preserve has a carrying capacity of 1000 animals and that the growth of the herd will follow the logistic curve  $p(t) = \frac{1000}{1 + 9e^{-0.1656t}}$  where  $t$  is measured in months. Graph the function and identify the horizontal asymptotes. What information do they give you about the problem? Estimate the population after 5 months. When will the population reach 500?