Exponential and Logarithmic Practice Real-Life Examples

Newton's Law of Cooling states that the rate at which an object cools is proportional to the difference between the temperature of the object and the surrounding temperature given by

$T_f = T_r + (T_o - T_r)e^{-rt}$ where T_f is the final temperature of the object after t minutes, T_r is the temperature of the surrounding air, T_o is the original temperature of the object and r is the rate at which the object is cooling.

1) Your parents are having friends over for tea and want to know how long after boiling the water it will be drinkable. If the temperature of your kitchen stays around 74°F and you found online that the rate of cooling for tea is 4.9%, how many minutes after boiling the water will the tea be drinkable (your parents prefer no warmer than 140°F and recall water boils at 212°F).

2) As you intern for a local crime scene investigation (CSI), you are asked to determine at what time the victim died. The rate at which the human body's temperature cools is 19.47%. The body's temperature was 72°F at 1:00am and the body temperature has been in a storage building at a constant 60°F, approximately what time did the victim die? Recall the average temperature for a human body is 98.6°F. Note in this situation, t is measured in hours.

Computer viruses have cost U.S. companies billions of dollars in damages and lost revenues over the last few years. One factor that makes computer viruses so devastating is the rate at which they spread. A virus can potentially spread across the world in a matter of hours depending on its characteristic and whom it attacks.

Consider the growth of the following virus. A new virus has been created and is distributed to 100 computers in a company via a corporate email. From these workstations the virus continues to spread. Let t = 0 be the time of the first 100 infections, and t = 17 minutes the population of infected computers grows to 200. Assume the antivirus companies are notable to identify the virus or slow its progress for 24 hours, allowing the virus to grow exponentially.

3) What will the population of infected computers be after 1 hour?

4) What will be the population be after 1 hour thirty minutes? After 24 hours?

Suppose another virus is developed and released on 100 computers. This virus grows according to $P(t) = 100(2)^{t/2}$, where t represents the number of hours from the time of introduction.

5) What is the doubling time for the virus?

6) How long will it take for the virus to infect 2000 computers?

The number of bacteria in a certain culture increases by 10% every hour until available space is depleted.

Only 100 bacteria are present to start the growth.

7) What is the growth factor of the bacteria?

8) Write an equation that models the growth of the bacteria when the space is unlimited.

9) Predict the number of bacteria present after 24 hours of growth.

Suppose you have $15,000 in equipment for your business. You expect the equipment will be worth 10% less each year.

Your friend says the equipment will be worth nothing in 10 years since that would be 100% depreciation.

10) Explain why your friend is incorrect.

11) Write an equation for this depreciation.

12) Find out how much the equipment will be worth in 10 years.