

## Lesson 10-6: Exponential Growth and Decay Applications

### Exponential Decay of the Form $y = a(1 - r)^t$

A cup of coffee contains 130 milligrams of caffeine. If caffeine is eliminated from the body at a rate of 11% per hour, how long will it take for half of this caffeine to be eliminated from a person's body?

### Exponential Decay of the Form $y = ae^{-kt}$

The half-life of a radioactive substance is the time it takes for half of the atoms of the substance to become disintegrated. All life on Earth contains the radioactive element Carbon-14, which decays continuously at a fixed rate. The half-life of Carbon-14 is 5760 years. That is, every 5760 years half of a mass of Carbon-14 decays away.

- a. What is the value of  $k$  for Carbon-14?
- b. A paleontologist examining the bones of a woolly mammoth estimates that they contain only 3% as much Carbon-14 as they would have contained when the animal was alive. How long ago did the mammoth die?

### Exponential Growth of the Form $y = a(1 + r)^t$

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

### Exponential growth of the Form $y = ae^{kt}$

As of 2000, China was the world's most populous country with an estimated population of 1.26 billion people. The population of China can be modeled by  $C(t) = 1.26e^{0.009t}$ . According to this model, what is China's population in 2017?

Name \_\_\_\_\_

**Algebra 2 – Examples of Exponential Functions – Applications**

1. **Exponential Decay ( $y = a(1 - r)^t$ )** Victoria bought a computer for \$2500. It is expected to depreciate at a rate of 17% per year.
  - a. What will be the value of the computer in 2 years?
  - b. When will the computer be worth \$1000?
2. **Exponential Decay ( $y = ae^{-kt}$ )** Radioactive iodine is used to determine the health of the thyroid gland. The value of  $k$  for the formula is 0.0856.
  - a. If there is 50 grams of iodine, how much will there be in one week (7 days)?
  - b. What is the half-life of this substance?
3. **Exponential Growth ( $y = a(1 + r)^t$ )** The Martins bought a condominium for \$85,000. Assume that the value will appreciate 5% per year.
  - a. How much will the condo be worth in 10 years?
  - b. When will the condo be worth \$150,000?
4. **Exponential Growth ( $y = ae^{kt}$ )** In 2000, the bird population in a certain area is 10,000. The number of birds increases continuously at a rate of 9%.
  - a. Predict the population in 2020.
  - b. When will the population double?