

Exponential Growth and Decay

Warm-UP

Write as a decimal.

1. 8%

.08

2. 2.4%

.024

3. 0.01%

.0001

Evaluate.

4. 3^6

729

5. $3^4 * 4^3$

5184

6. $2^4 * 2^3$

128

Bacteria are very small single-celled organisms that live almost everywhere on Earth. Most bacteria are not harmful to humans, and some are helpful, such as the bacteria in yogurt.

Bacteria reproduce, or grow in number, by dividing. The total number of bacteria at a given time is referred to as the population of bacteria. When each bacterium in a population of bacteria divides, the population doubles.

The population after n hours can be represented by the following exponential expression.

$$25 \times 2 \times 2 \times 2 \times \dots \times 2 = 25 \times 2^n$$

$$25 (2^n)$$

This expression, $25 * 2^n$, is called an **exponential expression** because the exponent, n is the variable and the base, 2, is a fixed number.

The **base** of an exponential expression is commonly referred to as **the multiplier**.

The population of the United States was 248,718,301 in 1990 and was projected to grow at a rate of about 8% per decade. [Source: U.S. Census Bureau (HRW Alg2)]

1.08

Predict the population, to the nearest hundred thousand, for the years 2010 and 2025.

$$248,718,301 (1.08)^t$$

multiplier

$$248,718,301 (1.08)^2$$

$$290,105,026$$

$$290,100,000 \text{ ppl}$$

$$248,718,301 (1.08)^{3.5}$$

$$325,604,866$$

$$325,600,000 \text{ ppl}$$

Suppose that you invested \$1000 in a company's stock at the end of 1999 and that the value of the stock increased at a rate of about 15% per year. Predict the value of the stock, to the nearest cent, at the end of the years 2004 and 2009.

$$1000(1.15)^t$$
$$1000(1.15)^5$$
$$\$2011.36$$

$$1000(1.15)^{10}$$
$$\$4045.56$$

Try This:

The population of Brazil was about 162,661,000 in 1996 and was projected to grow at a rate of about 7.7% **per decade**. Predict the population, to the nearest hundred thousand, of Brazil for 2016 and 2020. [Source: U.S. Census Bureau (HRW Alg2)]

$$162,661,000 (1.077)^t$$

$$188,752,111$$

$$188,700,000$$

$$194,357,420.2$$

$$194,400,000$$

The rate at which caffeine is eliminated from the bloodstream of an adult is about 15% per hour.

An adult drinks a caffeinated soda, and the caffeine in his or her bloodstream reaches a peak level of 30 milligrams.

$$1 - .15 = .85$$

Predict the amount, to the nearest tenth of a milligram, of caffeine remaining 1 hour after the peak level and 4 hours after the peak level.

$$30(.85)^1$$
$$25.5$$

$$30(.85)^t$$

$$30(.85)^4$$
$$15.7$$

Suppose that you buy a car for \$15,000 and that its value decreases at a rate of about 8% per year. Predict the value of the car, to the nearest cent, after 4 years and after 7 years.

$$15,000 (.92)^t$$

$$15,000 (.92)^4$$

$$10,745.89$$

$$15,000 (.92)^7$$

$$8,367.70$$

Try This:

A vitamin is eliminated from the bloodstream at a rate of about 20% per hour. The vitamin reaches a peak level in the bloodstream of 300 milligrams. Predict the amount, to the nearest tenth of a milligram, of the vitamin remaining 2 hours after the peak level and 7

$$300 (1 - 0.20)^t$$

$$300(0.80)^2$$

192

$$300(0.80)^7$$

62.9

Assign practice exponential growth & decay

find multiplier

26% growth

$$\underline{1.26}$$

52% decay

$$\underline{.48}$$

2% growth

$$\underline{1.02}$$

16.1% decay

$$\underline{.839}$$

$$\left(\frac{1}{3}\right)^x \text{ when } x = -2 = 9$$

$$6(.5)^{x-1} \text{ when } x = 3 = 1.5$$

$$4\left(\frac{1}{2}\right)^{3x+2} \text{ when } x = 2 = 0.016$$