Exponential Growth and Decay

College Algebra

Main Ideas

- Exponential functions model situations when you calculate the change from one time unit to the next by multiplying by a constant amount.
- When you multiply by a number larger than 1, the function models exponential growth.
- When you multiply by a number less than 1, the function models exponential decay.
- Exponential functions are very common in science and finance classes.

Exponential Functions

Definitions

A function $f(x) = P \cdot a^x$ is an exponential function. We call the number a the base and require that the base is a positive number. The number P is the initial condition. In most cases, we want P to be a positive number.

If $a > 1$, then the exponential function shows exponential growth with growth factor a.

If $a < 1$, then the exponential function shows exponential decay with decay factor a.

Converting Units for Growth or Decay Factors

Note

We sometimes want to change time units for different problems. For example, if we know the growth factor per year, we can turn it into a growth factor per decade. This will be useful when we talk about percentage change in the next section.

How To – Convert Growth or Decay Factors for Different Time Units

If a is the growth or decay factor for a time unit (like years) and A is the growth or decay factor for k repeated time units (like decades), then use the following formulas to convert between the growth or decay factors.

$$A = a^k \text{ and } a = A^{\frac{1}{k}}$$