Solve. Round to the nearest hundredth.

$5^x = 30$

$\log_5 30 = x$

Change of Base Formula:

Property	Change of Base Formula
For any positive numbers, M, b, and c, with $b \neq 1$ and $c \neq 1$,	

$$\log_b M = \frac{\log_c M}{\log_c b} = \frac{\log_{10} M}{\log_{10} b} = \frac{\log M}{\log b}$$

$$5^x = 30 \longrightarrow \text{Log}_5 30 = x \longrightarrow x = \frac{\text{Log}30}{\text{Log}5}$$

$x = 2.11$

Solve. Round to the nearest hundredth.

$2^{x+1} = 75$

$\log_2 75 = x+1$

$\frac{\log 75}{\log 2} - 1 = x$

$\boxed{5.23 = x}$

You invest $20,000 into an account that pays 6% annual interest.

1. Find the amount you'll have in the account after 20 years.

$100 + 6 = 106\%$

$y = 20{,}000(1.06)^{20}$

$b = 1.06$

$\boxed{y = \$64{,}142.71}$

2. Find the number of years it will take to turn that intial investment into $1,000,000. Round to the nearest hundredth.

$\frac{1{,}000{,}000}{20{,}000} = \frac{20{,}000(1.06)^t}{20{,}000}$

$50 = 1.06^t$

$\log_{1.06} 50 = x$

$\frac{\log 50}{\log 1.06} = x = \boxed{67.14 \text{yrs}}$

Simple Interest: $I = Prt$

This is when you only earn interest on the original amount of money you invested (Principal) no matter how far into the future you are calculating interest.

Compounding Interest:

After each interest calculation you add that amount to the Principal. This means that the next time you calculate interest you are getting interest on a larger amount (the original Principal plus previous interest amounts).

Compounding Interest Formula:

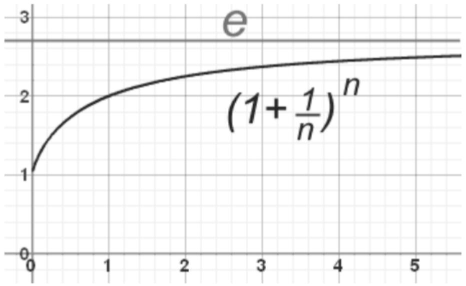
$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

P = principal amount (the initial amount you borrow or deposit)
r = annual rate of interest (as a decimal)
t = number of years the amount is deposited or borrowed for.
A = amount of money accumulated after n years, including interest.
n = number of times the interest is compounded per year

The number e.

Frequency of compounding	#times per year compound interest (n)	$1\left(1+\frac{1}{n}\right)^n$	Dollar Value
Annually	$n = 1$	$1\left(1+\frac{1}{1}\right)^1$	2.00
Semiannually	$n = 2$	$1\left(1+\frac{1}{2}\right)^2$	2.25
quarterly	$n = 4$	$1\left(1+\frac{1}{4}\right)^4$	2.441
monthly	$n = 12$	$1\left(1+\frac{1}{12}\right)^{12}$	2.613
weekly	$n = 52$	$1\left(1+\frac{1}{52}\right)^{52}$	2.693
daily	$n = 365$	$1\left(1+\frac{1}{365}\right)^{365}$	2.715
hourly	$n =$ 8760	$\vdots$	2.718
every minute	$n =$ 525600	$\vdots$	2.718
every second	$n =$ 31536000		2.718

the value of $\boxed{(1 + 1/n)^n}$ approaches $\boxed{e}$ as n gets bigger and bigger:



n	$(1 + 1/n)^n$
1	2.00000
2	2.25000
5	2.48832
10	2.59374
100	2.70481
1,000	2.71692
10,000	2.71815
100,000	2.71827

Where is e used?

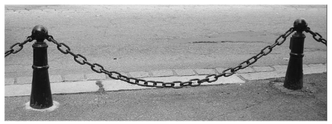
Like π, e is an irrational number most often found in formulas.

Catenary: A catenary is the shape that a cable assumes when it's supported at its ends and only acted on by its own weight. It is used extensively in construction, especially for suspension bridges

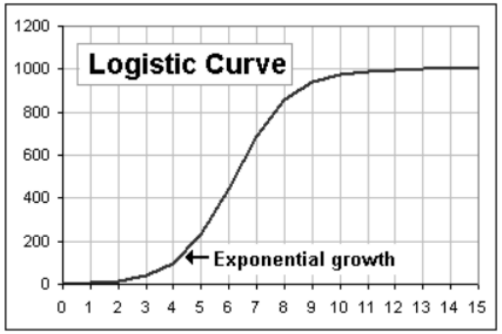
Equation of a Catenary:

$$y = \frac{a}{2}\left(e^{\frac{x}{a}} + e^{\frac{-x}{a}}\right)$$

Examples of Catenarys:



Logistic Growth: Starts out as Exponetial Growth but then levels out due to external contraints.



$$N(t) = \frac{A}{1 + Be^{-rt}}$$

Compounding Interest Formula:

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

The more often interest is calculated the more money you will earn.

What is more often than every second?

All the time..... Continuously

Compounding Interest Continuously

$$y = Pe^{rt}$$

years

Amount after t years

Principal

Annual Interest rate as a decimal

You invest $20,000 in an account that pays 6% annual interest compounded CONTINUOUSLY. How much would you have after 25 years?

$$y = Pe^{rt}$$

$$20{,}000\, e^{.06 * 25}$$

$$\boxed{= \$89{,}633.78}$$

How would this compare to getting interest compounded annually?

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

$$20{,}000\left(1 + \frac{.06}{1}\right)^{1 \cdot 25}$$

$$\boxed{= \$85{,}837.41}$$

Log_e is called a Natural Logarithm

and is written as LN or Ln or ln

$\text{Log}_e 7.5 = 0.06x$

$\ln 7.5 = 0.06x$