Exponential Functions

Warm-UP

Evaluate.

1. 3^4 81
2. 3^0 1
3. (-4)^2 16
4. 4^-2 $\frac{1}{16}$

Evaluate each expression for x = 2.

5. x^5 32
6. 5^x 25
7. 5^-x $\frac{1}{25}$
8. $\left(\frac{1}{5}\right)^x$ $\frac{1}{25}$

Exponential Function

The function $f(x) = b^x$ is and **exponential function** with **base** b, where b is a positive real number other than 1 and x is any real number.

Examine the table at the left and graph the function $y = 2^x$. Notice that as x-values decrease, the y-values for $y = 2 x$ get closer and closer to 0, approaching the x-axis as an asymptote An asymptote is a line that a graph approaches (but does not reach) as its x- or y-values become very large or very small

The graphs of f(x) = 2^x and $g(x) = \left(\frac{1}{2}\right)^x$

exhibit the two typical behaviors for exponential functions. Graph both in your calculator.

Exponential Growth and Decay

When b > 1 , the function f(x) = b^x represents exponential growth.

When 0 < b < 1 , the function f(x) = b^x represents exponential decay.

Exponential growth functions and exponential decay functions of the form y = bx have the same domain, range, and y-intercept. For example:

Func tion	Domain	Range	y-intercept
f(x) = 2^x	All real #s	All + real #s	1
$g(x) = \left(\frac{1}{2}\right)^x$	All real #s	All + real #s	1

Graph f(x) = 2^x along with each function below. Tell whether each function represents expontial growth or exponential decay. Then give the y-intercept.

1. y = 3 * f(x)

$y_1 = 3 \times 2^\wedge x$

growth

y-int = 3

2. y = 5* f(-x)

5×2^{-x}

decay int = 5

3. ½ * f(-x)

$\frac{1}{2} \times 2^\wedge -x$

decay int $\frac{1}{2}$

4. 4 * f(x)

4×2^x

growth int 4

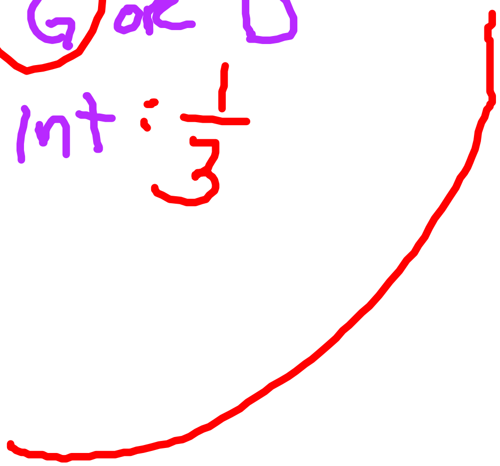
Try These:

$f(x) = 2^x$

$y = 1/3 * f(x)$

G or D

int: $\frac{1}{3}$



$y = \frac{1}{4} * f(-x)$

G or D

int $\frac{1}{4}$

Compound Interest Formula

The total amount of an investment, A, earning compound interest is

$A = P(1+r)^t$

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

where P is the principal, r is the annual interest rate, n is the number of times interest is compounded per year, and t is the time in years.

Find the final amount of a \$100 investment after 10 years at 5% interest compounded annually, quarterly, and daily.

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

$= 100\left(1+\left(\frac{.05}{1}\right)\right)^{(1\times10)} = 162.89$

$= 100\left(1+\frac{.05}{4}\right)^{(4\times10)} = 164.36$

$= 100\left(1+\left(\frac{.05}{365}\right)\right)^{(365\times10)} = 164.87$

Find the final amount of a \$500 investment after 8 years at 7% interest compounded annually, quarterly, monthly, and daily.

$A = 500\left(1+\frac{.07}{4}\right)^{(4\times8)}$

$= 859.09$ $\quad$ 871.11 $\quad$ 873.91 $\quad$ 875.29

To tell if an equation is linear, quadratic or exponential,
Ask yourself:

Is the power on x 1?	linear
Is the x squared?	quadratic
Is the x the exponent?	exponential