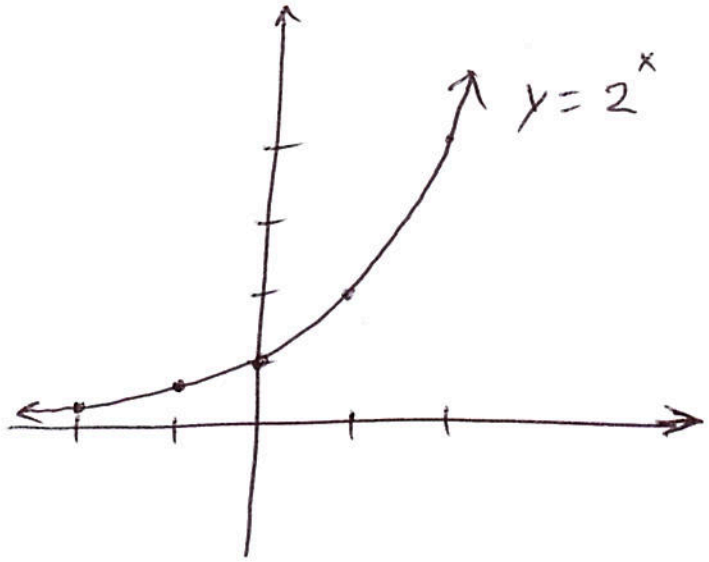
Sec 7.6 Modeling Data

Exponential, Logarithmic, and Quadratic Functions

The exponential function with base b is defined by $y = b^x$ or $f(x) = b^x$ where $b > 0$, $b \neq 1$ and x is any real number.

x	2^x
-2	$\frac{1}{4}$
-1	$\frac{1}{2}$
0	1
1	2
2	4



Never touches x-axis.

$g(x) = 2.566(1.017)^x$ models world population in billions x years after 1949.

Use the model to estimate world population in 1980.

$$\begin{array}{r} 1980 \\ -1949 \\ \hline 31 \end{array}$$

$2.566(1.017)^{31} \approx 4.3272$

Approx 4.327 billion people

The transcendental number e

$e \approx 2.71828$ irrational

This number is the natural base for an exponential function.

$f(x) = e^x$ is The Exponential Function

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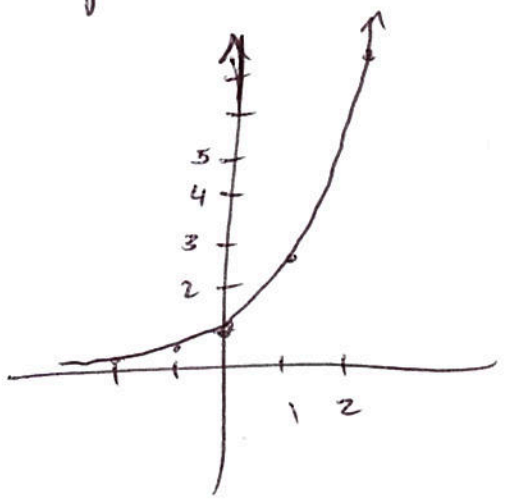
Find e and/or e^x on calculator

graph $f(x) = e^x$



x	e^x
-2	0.135
-1	0.368
0	1
1	2.718
2	7.389

Logarithmic Functions

For $x > 0$ and $b > 0$, $b \neq 1$,

$y = \log_b x$ is equivalent to $b^y = x$.

The function $f(x) = \log_b x$ is the logarithmic function with base b.

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$2^3 = 8$ $\qquad$ $\log_2 8 = 3$

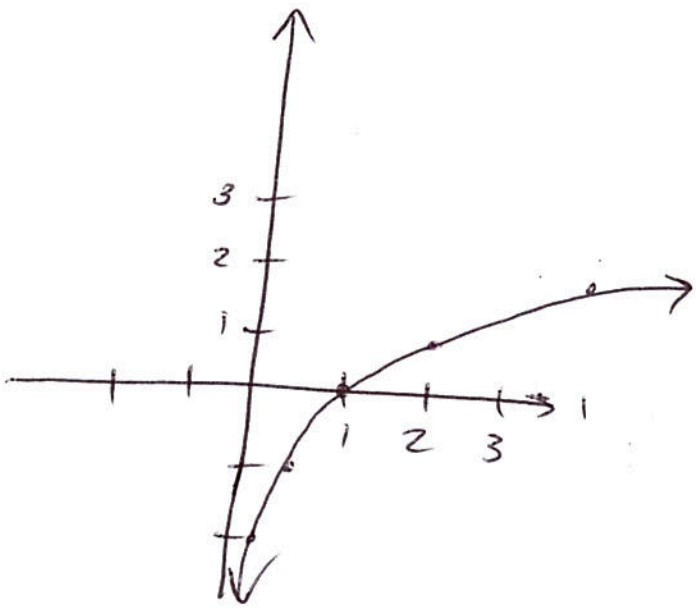
$3^4 = 81$ $\qquad$ $\log_3 81 = 4$

$\cancel{25^{1/2} = 5}$ $\qquad$ $\log_5 25 = 2$

$5^2 = 25$

$3^{-2} = \frac{1}{9}$ $\qquad$ $\log_3 \frac{1}{9} = -2$

x	$\log_2 x$
$\frac{1}{4}$	-2
$\frac{1}{2}$	-1
1	0
2	1
4	2



The function $f(x) = -11.6 + 13.4 \ln x$ models the temperature increase in a closed car after x minutes.

Find the temperature increase after 1 minute.

Find the temperature increase after 30 minutes

$-11.6 + 13.4 \ln 1 = -11.6$ 1 minute model is no good.

$-11.6 + 13.4 \ln 30 = 33.976$

$\approx 34°$. matches empirical data.

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- A quadratic function is any function that can be expressed in the form $f(x) = ax^2 + bx + c$ where a, b, and c are real numbers with $a \neq 0$.

The graph of such a function is a parabola.

If $a > 0$ opens up

If $a < 0$ opens down.

A parabola is symmetric about its axis.

The vertex of the graph of $y = ax^2 + bx + c$ occurs where

$$x = \frac{-b}{2a}.$$

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Example: Graph $f(x) = x^2 - 3x - 4$

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1. Opens (up) or down ?

2. Vertex $b = -3$ $a = 1$

$$\frac{-b}{2a} = \frac{-(-3)}{2(1)} = \frac{3}{2}$$

$$f\left(\frac{3}{2}\right) = \left(\frac{3}{2}\right)^2 - 3\left(\frac{3}{2}\right) - 4$$

$$= \frac{9}{4} - \frac{9}{2} - 4 = -\frac{9}{4} - \frac{16}{4} = -\frac{25}{4}$$

Vertex $\left(\frac{3}{2}, -6\frac{1}{4}\right)$

3. x-intercepts $y = 0 = x^2 - 3x - 4$

$$= (x-4)(x+1)$$

$x = 4$ $x = -1$

4. y-intercepts $x = 0$ $0^2 - 3(0) - 4 = -4$

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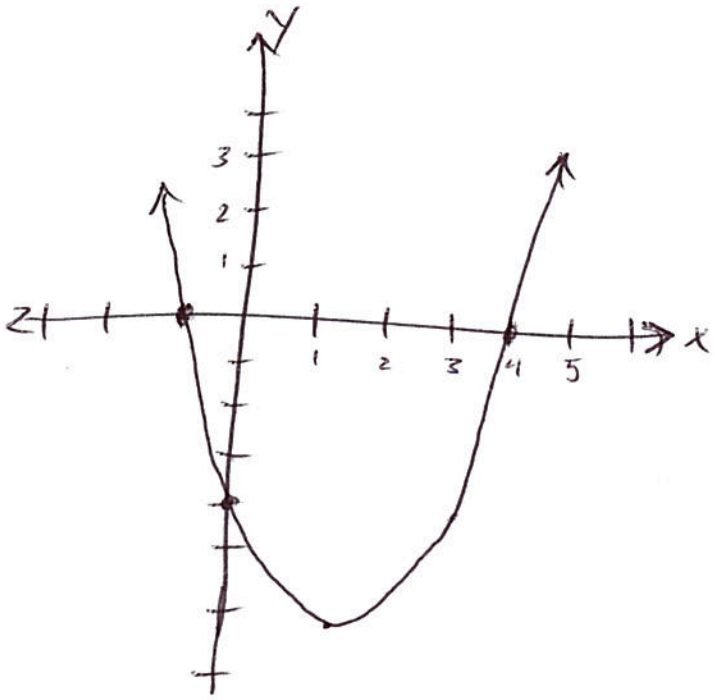
Plot.
connect

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