§3.1 Exponential Functions and Their Graphs

Exponential Function:

If $a > 0$, $a \neq 1$, and x is any real number, then

$f(x) = a^x$ defines the **exponential function** with base a.

Example 1 : Evaluate the following exponential expressions with your calculator.

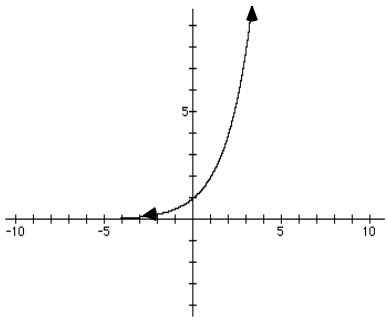
a) $2^{-3.1}$ b) $2^{-\pi}$ c) $12^{5/7}$ d) $(0.6)^{3/2}$

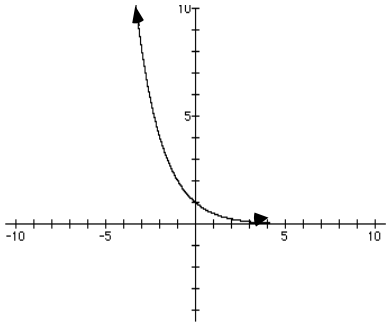
Graphing Exponential Functions

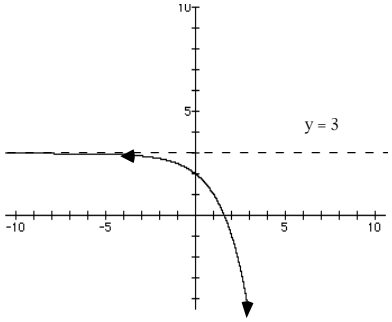
Graphs of the Form: $f(x) = a^x$

1) The point (0, 1) is on the graph.
2) If $a > 1$, f is an increasing function; If $0 < a < 1$, f is an decreasing function.
3) The x-axis is a horizontal asymptote.
4) The domain is $(-\infty,\infty)$ and the range is $(0,\infty)$.

Graph $f(x) = 2^x$ Graph $g(x) = 2^{-x}$ Graph $h(x) = -2^x + 3$







Horizontal Asymptote: The line in which a graph approaches (gets closer and closer to)

Increasing Function: A function where as x-values increase so do the y-values.

Decreasing Function: A function where as x-values increase y-values decrease.

Exponential Equations (TYPE 1)

Example 2: Solve

a) $\left(\frac{1}{3}\right)^x = 81$

b) $1.5^{x+1} = \left(\frac{27}{8}\right)^x$

The Natural Base e

$e \approx 2.71828.....$

Example 3: Use a calculator to evaluate each expression.

a) e^{-2} b) e^{-1} c) $e^{0.25}$ d) $e^{-0.3}$

Formulas for Compound Interest:

After **t** years, the balance **A** in an account with principal **P** and annual interest rate **r** (in decimal form) is given by the following formulas:

1. For **n** compoundings per year: $\boxed{A = P\left(1 + \frac{r}{n}\right)^{n \cdot t}}$

2. For continuous compounding: $\boxed{A = Pe^{r \cdot t}}$

Example 4: A total of $12,000 is invested at an annual interest rate of 9%. Find the balance after 5 years if it is compounded:

a) quarterly.

b) continuously.