3.1 Exponential Functions and Their Graphs

Part 2: The Natural Exponential & Applications

***A review of exponent properties*:**

Ex a) When comparing $f(x) = 2^x$ and $k(x) = 2^{-x}$, how could you write $k(x)$ in terms of $f(x)$?

PROPERTY	EXAMPLE
Product of Powers $a^m \bullet a^n = a^{m+n}$	$x^2 \bullet x^7 \bullet x = x^{2+7+1} = x^{10}$ $3^2 \bullet 3^7 = 3^{2+7} = 3^9 = 19{,}683$
Power of a Power $(a^m)^n = a^{mn}$	$(n^3)^4 = n^{3\bullet 4} = n^{12}$ $(4^2)^3 = 4^{2\bullet 3} = 4^6 = 4{,}096$
Power of Product $(ab)^m = a^m b^m$	$(xy)^5 = x^5y^5$ $(42 \bullet 12)^2 = 42^2 \bullet 12^2 = 254{,}016$
Quotient of Powers $\frac{a^m}{a^n} = a^{m-n}$	$\frac{x^{11}}{x^4} x^{11-4} = x^7$ $\frac{6^{12}}{6^8} = 6^{12-8} = 6^4 = 1{,}296$
Power of a Quotient $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$, $b \neq 0$	$\left(\frac{x}{y}\right)^5 = \frac{x^5}{y^5}$ $\left(\frac{x^2}{4y}\right)^3 = \frac{x^{2\bullet 3}}{4^3y^3} = \frac{x^6}{64y^3}$
Zero as an exponent $a^0 = 1 \quad a \neq 0$	$5^0 = 1$ $x^0 = 1$
Negative Exponents $a^{-x} = \frac{1}{a^x}$	$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$ $\frac{1}{y^{-7}} = y^7$

Rewrite each using properties of exponents.

Ex b)

Ex c)

Ex d)

Ex e)

Ex f)

Ex g) Using properties of exponents, which of these are equivalent?

The One-to-One Property:

- For $a > 0 \;\; and \;\; a \neq 1, \quad a^x = a^y$ if and only if $x = y$
- Used to solve exponential functions that:

- How to use the one-to-one property:

- <u>Use the one-to-one property to solve each:</u>

Ex h)

Ex i)

Ex j)

Natural Base e

- e is an irrational number (never ending and non-repeating decimal)
- $e \approx 2.718281828$ ....
- This number, e, is called the natural base
- The function $f(x) = e^x$ is called the natural exponential function
- There is a button for e on your calculator, and when pushed it prompts you to input an exponent (x)

Using your calculator, evaluate the following if $f(x) = e^x$. Round to the nearest thousandth.

Ex k)

Ex l)

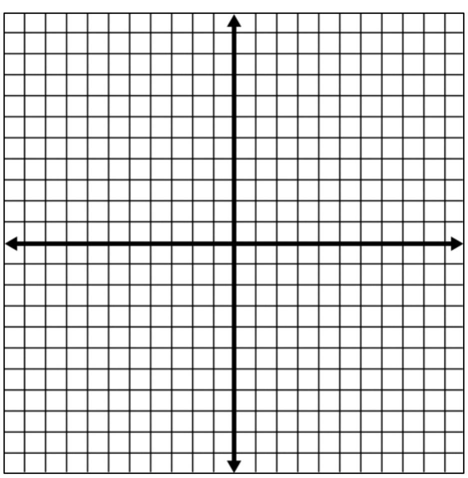
Ex m)

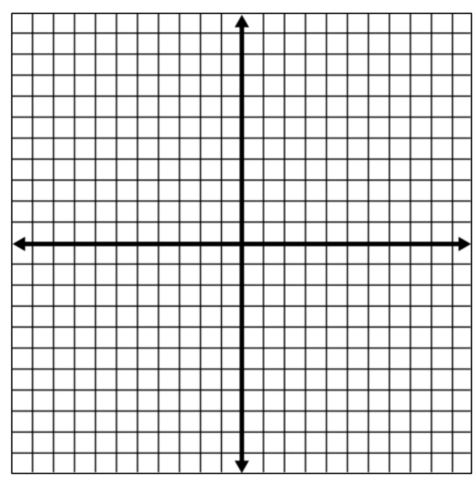
Graphing Natural Exponential Functions

Graph each natural exponential function (plot 4-6 points per function, to your best accuracy)

Ex n)

Ex o)





Applications of Exponential Functions

<u>When do we use exponentials in real life?</u>

By the time you're an adult… you'll use it for EVERYTHING!!!

- Buying or renting a car, buying or renting a house or apartment, student loans for college, lending others money if you have a large amount, investing in companies or stocks, etc!

Compound Interest

Compound interest:

Ex p)