## hp calculators

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Basic logarithm and exponential relationships
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Practice solving logarithm and exponential problems

## Basic logarithm and exponential relationships

Exponential and logarithm are related functions as expressed by $b=a^{x}$, where $x$ is unknown power, $a$ is the base (known), and $b$ is the value resulting from $a^{x}(b>0)$. The expression that isolates $x$ so $x$ can be computed when $a$ and $b$ are known is:

$$
x=\frac{\log (b)}{\log (a)} \quad(b>0, a>0, a \neq 1)
$$

The restriction $a \neq 1$ applies because if $a=1$ then the $\log (\mathrm{a})=0$ generating an undefined value for x . Some of the properties related to logarithms and exponents are shown in the examples below.

## Logarithm and exponential functions on the HP12C

There are two exponent-related and one logarithm-related functions in the HP12C, and the keys related to these functions are $y^{x x}, g e^{x}$ and $g\left[L N\right.$. $y^{x x}$ computes $y$ raised to the $x$ power while $g e^{x}$ computes $e$ raised to the power of the number in the display ( $e$ is the Napier's number $2.718281828 \ldots$...). $g$ LN computes the natural logarithm of the number in the display.

## Practice with solving logarithm and exponential problems

Example 1: Continuous compounding is often encountered in conversions from a nominal to an effective interest rate. The following expression is used:

$$
\mathrm{EFF}=e^{\mathrm{NOM}}-1 \quad \text { Figure } 1
$$

What is the effective annual rate equivalent to a nominal rate of $6 \%$, compounded continuously?
Solution: The expression below represents the problem:

$$
\mathrm{EFF}=e^{0.06}-1 \quad \text { Figure } 2
$$

The following keystroke sequence can be used to compute the effective rate:

$$
0 \cdot 0 \boxed{0} \sqrt{9} \mathrm{e}^{x} \sqrt{-1}
$$

Answer: A nominal interest rate of $6 \%$, compounded continuously is equivalent to an effective interest rate of $6.18 \%$.

## Example 2: When continuous compounding is considered in conversions from effective to nominal interest rate, the

 following expression is used:$$
\mathrm{NOM}=\ln (\mathrm{EFF}+1) \quad \text { Figure } 3
$$

What is the nominal interest rate, compounded continuously, equivalent to an effective interest rate of 6.18\%?

Solution: The expression below represents the problem:

$$
\mathrm{NOM}=\ln (0.0618+1) \quad \text { Figure } 4
$$

The following keystroke sequence can be used to compute the effective rate:


Answer: An effective interest rate of $6.18 \%$ is equivalent to a nominal interest rate of $6 \%$, compounded continuously.
Example 3: Evaluate the following expressions and find $x$ :

$$
x=\sqrt[-4]{81}_{(1)} \quad x=\log _{10}(200)_{(2)} \quad x=\log _{3}(20)-\log _{3}(5)_{(3)}
$$

Solution: The original expression in (1) can be rewritten like this:

$$
\sqrt[-4]{81}=81^{-(1 / 4)}
$$

To find the solution, press:
811 ENTER $4 \sqrt{1 x}$ CHS $y^{x}$

## $0.3 \exists$

Figure 5
In expression (2), one of the basic logarithm properties can be applied:

$$
\log _{a}(b)=\frac{\ln (b)}{\ln (a)} \quad \text { Figure } 6
$$

So expression (2) is rewritten:

$$
\log _{10}(200)=\frac{\ln (200)}{\ln (10)} \quad \text { Figure } 7
$$

To find the solution, press:
$200 \mathrm{DLN} 10 \mathrm{OLN} \div$

### 2.36

Figure 8
hp calculators
HP 12C Logarithm and Exponential Functions
In expression (3), the following sequence can be used:

### 1.25

Figure 9

Answer: $\quad$ The answers are:

$$
\begin{aligned}
& x=\sqrt[-4]{81} \Rightarrow x=0.33 \\
& x=\log _{10}(200) \Rightarrow x=2.30 \\
& x=\log _{3}(20)-\log _{3}(5) \Rightarrow x=1.26
\end{aligned}
$$

