HP-80 APPLICATION NOTES

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CALCULATING LOGS, ANTI-LOGS, AND ROOTS OF NUMBERS

GENERAL

This Application Note will be of assistance to those HP-80 owners who require the ability to calculate ***common and natural logarithms, anti-logarithms (base 10 and base e), and the "nth" root of a number.***

COMMON (BASE 10) AND NATURAL (BASE e) LOGARITHMS

The following keystrokes will simultaneously calculate the common logarithm (log) and natural logarithm (ln) of a number (B).

Keystrokes:

1. 900 [i] 1 [PV] B [FV] [n] ⟶ log B (Base 10)
2. [x⇄y] ⟶ ln B (Base e)

Example:

Determine the common logarithm and natural logarithm of 256.

Procedure:	***See Displayed:***
1. 900 [i] 1 [PV] 256 [FV] [n] ⟶	2.41 (log, base 10)
2. [x⇄y] ⟶	5.55 (ln, base e)

LOGARITHMS FOR ANY BASE

The following keystrokes solve for the exponent c in the equation $A^c = B$ when A and B are known. This procedure may be labeled "finding the logarithm of B to the base A".

The natural logarithm of B will again be available in the y register.

Keystrokes:

1. A [SAVE↑] 1 [−] 100 [×] [i] 1 [PV] B [FV] [n] ⟶ c
2. [x⇄y] ⟶ ln B (base e)

Example:

Find the exponent c in the equation: $16^c = 4096$

Procedure:	***See Displayed:***
1. 16 [SAVE↑] 1 [−] 100 [×] [i] 1 [PV] 4096 [FV] [n] ⟶	3.00 (log 4096, base 16)
2. [x⇄y] ⟶	8.32 (ln 4096, base e)

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Note:

When calculating logarithmic values, features that are required for other purposes are being used. Specifically, when solving for [n] in the compound interest equation,

$$FV = PV\,(1 + i/100)^n$$

the HP-80 uses natural logarithms and the expression becomes;

$$n = \frac{\ln(FV/PV)}{\ln(1 + i/100)}$$

Therefore, the keystroke sequence, 900 [i] 1 [PV] B [FV] [n] , results in the following solution:

$$n = \frac{\ln(B/1)}{\ln\left(1 + \frac{900}{100}\right)} = \frac{\ln(B)}{\ln(10)} = \log B \text{ (base 10)}.$$

Similarly the keystroke sequence,

A [SAVE ↑] 1 [−] 100 [×] [i] 1 [PV] B [FV] [n] , gives:

$$\frac{\ln B}{\ln A} = \log B \text{ (base A)}$$

As an intermediate step the HP-80 places the ln (FV/PV) in the y register, and for the values discussed this becomes ln (B/1) or simply ln B (base e).

ANTI-LOGARITHMS (BASE e)

The following keystrokes solve for B in the equation $e^c = B$, where e is the base of natural logarithms, and the exponent c is the natural logarithm of B. Step 1 generates the value of e correct to 9 decimal places.

Keystrokes:

1. 1.000001 [SAVE ↑] 1000000 [y^x] ————→ 2.718281828
2. c [y^x] ————→ B

Example:

Determine the number whose natural logarithm equals 2.36.

Procedure:	***See Displayed:***
1. 1.000001 [SAVE ↑] 1000000 [y^x] ————→	2.72
2. 2.36 [y^x] ————→	10.59

Note:

Since a portion of the value of e repeats itself some will find it easier to remember 2.718281828 than the keystrokes that generate this number. In this case step 1 may be replaced by simply entering e and pressing [SAVE ↑].

ANTI-LOGARITHMS (BASE 10)

The following keystrokes solve for B in the equation $10^c = B$ where the exponent c is the common logarithm of B.

Keystrokes:

10 [SAVE ↑] c [y^x] ————→ B

Example:

Find the number whose common logarithm is 2.41.

Procedure: | *See Displayed:*

10 [SAVE ↑] 2.41 [y^x] ——→ 257.04

"nth" ROOT OF A NUMBER

The key sequence, A [ ] (Gold Key) [$\sqrt{x}$], where A is a positive number, will calculate the 2^{nd} root (i.e., square root) of A. This operation is commonly written as $\sqrt{A}$ or $\sqrt[2]{A}$. However, the square root of A may also be written in mathematical notation as

$$A^{1/2}$$

and in this form it may be said that A is being raised to the ½ power. A more general representation for finding the "nth" root of a number would therefore be:

$$A^{1/n}$$

where n = 2 for square or 2^{nd} root, n = 3 for cube or 3^{rd} root, and so on. Since the [y^x] key will raise a positive number to any power, the HP-80 may be used to calculate the "nth" root of positive numbers as shown below.

Keystrokes:

A [SAVE ↑] 1 [SAVE ↑] n [÷] [y^x] ——→ "nth" root of A

Example:

Find the cube (3^{rd}) root of 6859.

Procedure: | *See Displayed:*

6859 [SAVE ↑] 1 [SAVE ↑] 3 [÷] [y^x] ——→ 19.00