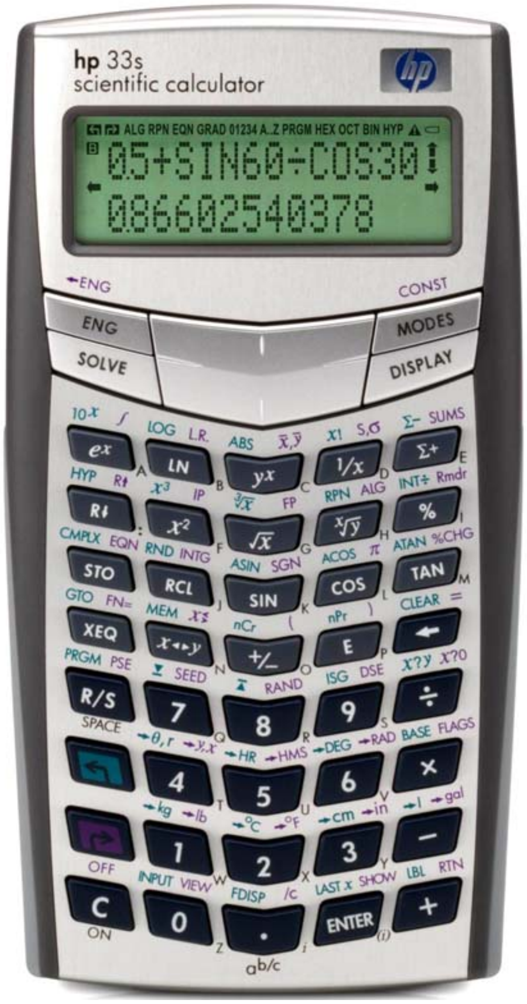
hp calculators

HP 33S Base conversions and arithmetic

Numbers in different bases

Practice working with numbers in different bases



Numbers in different bases

Most numbers we work with day-to-day are in base 10. There are applications within the computer world that require the use of numbers in other bases. The number 24 in base 10 can be translated into base 16 by the following procedure. Just as each digit's location in base 10 can be thought of as a power of ten (the ones' place, the tens' place, the hundreds' place, etc), each digit's location in base 16 can be thought of as a power of 16. Each digit in a base ten number can hold a value from 0 to 9. In base 16, each digit can hold a value from 0 to F, where F corresponds to the value 15 in a base 10 number. Translating 24 from base 10 to base 16 would require a 1 in the second location of the base 16 number (and would convert 16 of the 24 number's value) and an 8 in the second location of the base 16 number. Therefore, 24 base 10 is equal to 18 in base 16. A similar process could be used to convert 24 base 10 to base 8 or base 2.

Basic arithmetic functions will work with numbers in different bases, but these numbers must be integers – decimals are allowed for real numbers only, not binary numbers.

On the HP 33S, numbers can be represented in bases 2, 8, 10 and 16, or binary, octal, decimal and hexadecimal. The HP 33S can work with numbers in bases 2, 8 and 16 that are 36 bits in length or less. Since the leftmost "bit" is used to indicate a negative number, the largest positive binary number is 0 followed by thirty-five 1's. This means that the largest hexadecimal number that can be entered or generated as an answer is 7FFFFFFFF, (equal to 34,359,738,367 in base 10, and 377777777777 in base 8). This is because the HP 33S uses a 36 bit binary word space to represent numbers in these different bases. Decimal numbers are not limited in this fashion, since they can be represented as floating point numbers.

The HP 33S calculator provides the ability to easily work with numbers in different bases, as the following sample problems illustrate.

Practice working with numbers in different bases

<u>Example 1:</u> Convert 4000 base 10 to a base 8 octal number.

<u>Solution:</u> The keystrokes to do this are the same for both RPN and algebraic modes. First, make sure the HP 33S is in DEC mode to enter the base 10 number.

[↰] [BASE] [1]
[4] [0] [0] [0] [↰] [BASE] [3]

Figure 1

<u>Answer:</u> 7640 base 8. Figure 1 shows the result in RPN mode.

<u>Example 2:</u> Add 7F6 base 16 to 1011001 base 2 and display the result in base 10.

<u>Solution:</u> First, make sure the calculator is in HEX mode to enter the base 16 number. Note that the [x^2] key below is used to enter the hexadecimal F value.

[↰] [BASE] [2]

In RPN mode:

[7] [x^2] [6] [↰] [BASE] [4]
[1] [0] [1] [1] [0] [0] [1] [↰] [BASE] [1] [+]

In algebraic mode:

[7] [x^2] [6] [↰] [BASE] [4] [+]
[1] [0] [1] [1] [0] [0] [1] [↰] [BASE] [1] [ENTER]

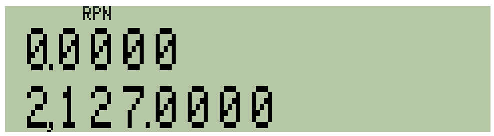


Figure 2

Answer: 2127 base 10. Figure 2 shows the result in RPN mode.

Example 3: Multiply FFF base 16 by 777 base 8 and display the result as a real number.

Solution: First, make sure the calculator is in HEX mode to enter the base 16 number. Note that the [x^2] key below is used to enter the hexadecimal F value.

[↰] [BASE] [2]

In RPN mode:

[x^2] [x^2] [x^2] [↰] [BASE] [3]
[7] [7] [7] [↰] [BASE] [1] [×]

In algebraic mode:

[x^2] [x^2] [x^2] [↰] [BASE] [3] [×]
[7] [7] [7] [↰] [BASE] [1] [ENTER]

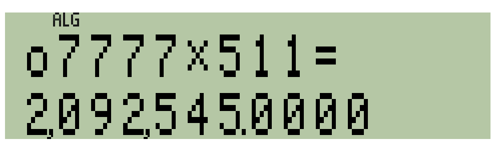


Figure 3

Answer: The result is 2,092,545. Figure 3 shows the result in algebraic mode.

Example 4: Subtract 42 base 8 from 101111 base 2 and then display the two's complement of the result in base 2.

Solution: First, make sure the calculator is in BIN mode to enter the base 2 number.

[↰] [BASE] [4]

In RPN mode:

[1] [0] [1] [1] [1] [1] [↰] [BASE] [3]
[4] [2] [↰] [BASE] [4] [−] [+/−]

In algebraic mode:

[1] [0] [1] [1] [1] [1] [↰] [BASE] [3] [−]
[4] [2] [↰] [BASE] [4] [−] [ENTER] [+/−]

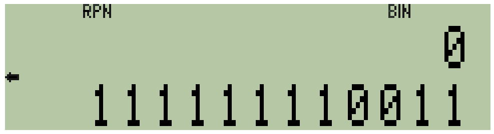


Figure 4

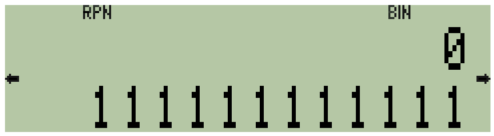


Figure 5

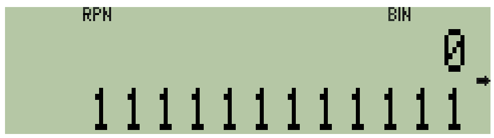


Figure 6

Answer: The result is 111111111111111111111111111111110011. This is equivalent to –13 in base 10.

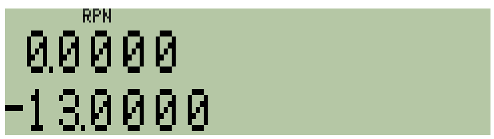


Figure 7

Figures 4, 5, and 6 display portions of the answer in RPN mode. Figure 4 shows the rightmost 12 digits of the result, while Figure 5 shows the middle 12 digits of the result and Figure 6 shows the leftmost 12 digits of the result. Figure 7 shows the result converted into base 10.

Note that when the result is displayed, there is an arrow pointing to the left in the display to indicate that the result has digits in the answer that flow off the display screen to the left. Press the left portion of the cursor key at the top of the HP 33S one time to view the next 12 digits of the answer to the left and then press it again to view the leftmost 12 digits of the answer.