

## On the Subject of Bases

*What's on second.*

- You will be presented with 2 numbers, an operator between them, and a 0 - 9 number pad.
- The two numbers are not necessarily in [base](#) (also known as "radix") 10, our standard number base. You will need to figure out what base the numbers are in, and the base may differ between the two numbers. You can [convert them](#) back to base 10 if you would like to.
- After figuring out what the answer to the simple math problem is, you must enter that number into the keypad and hit submit. However, your answer may also need to be converted to another base before submission. Entering in the incorrect answer, or the correct answer in the wrong base, will result in a strike.
- Follow the steps below to figure out which base all three numbers are in. If any of the bases evaluate to ten, use ten. Otherwise, take the number you get modulo 7, then add two.
- **Note:** Always submit the absolute value of the answer you get, and do not prepend your answer with any zeros, as that is counted as incorrect.

### Calculating Bases

|                       |   |
|-----------------------|---|
| <b>First Number:</b>  | # Lit indicators +<br>Last # in Serial Number +<br>3 (if DVI-D port exists)     |
| <b>Second Number:</b> | # UnLit indicators +<br>First # in Serial Number +<br>6 (if Serial port exists) |
| <b>Answer:</b>        | # Port Plates +<br>2 (if IND indicator exists)                                  |

## So You Want to Know About Bases?

Bases are weird things. Basically a base is how many digits are in the number system. For example, the standard number system we use in everyday life is in base 10. That means we have ten digits before switching over to a two digit number: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Binary is base 2. That system has two digits, 0 and 1. Base 7 would have seven digits, 0, 1, 2, 3, 4, 5, and 6. The following table shows the number 27 represented in the 9 bases used on this module.

| Base | 27 In The Base |
|------|----------------|
| 2    | 11011          |
| 3    | 1000           |
| 4    | 123            |
| 5    | 102            |
| 6    | 43             |
| 7    | 36             |
| 8    | 33             |
| 9    | 30             |
| 10   | 27             |

## So You Want to Convert Between Bases?

Converting between bases can be a challenge. This section will show how to convert between bases using a series of examples.

### Example 1:

**Convert 235 (base 8) to base 10**

Above each of the digits in your number, list the power of the base that the digit represents. See the example below. It is now a simple process of multiplication and addition to determine your base 10 number. In this example you have:

$8^2 \ 8^1 \ 8^0$   
2 3 5

$$5 \times 8^0 = 5$$

$$3 \times 8^1 = 24$$

$$2 \times 8^2 = 128$$

Then you add them all together.  $5 + 24 + 128 = 157$ . 235 in base 8 is 157 in base 10.

### Example 2:

Convert 1011 (base 2) to base 10

We do the same thing as before:

$$1 \times 2^0 = 1$$

$$1 \times 2^1 = 2$$

$$0 \times 2^2 = 0$$

$$1 \times 2^3 = 8$$

Then, again, you add them all together.  $1 + 2 + 0 + 8 = 11$ . 1011 in base 2 is 11 in base 10.

### Example 3:

Convert 5 (base 10) to base 2

This is slightly different. Instead of a series of multiplications, we need a series of divisions. Here are the steps:

1. Divide the "desired" base (in this case base 2) INTO the number you are trying to convert.
2. Write the quotient (the answer) with a remainder like you did in elementary school.
3. Repeat this division process using the whole number from the previous quotient (the number in front of the remainder).
4. Continue repeating this division until the number in front of the remainder is only zero.
5. The answer is the remainders read from the bottom up.

Here is an example:

$$\begin{array}{r} 2 \overline{) 5} \quad 2 \text{ R } 1 \\ \underline{4} \phantom{0} \\ 1 \text{ R } 0 \\ 2 \overline{) 2} \phantom{0} \\ \underline{2} \phantom{0} \\ 0 \text{ R } 1 \\ 2 \overline{) 1} \\ \underline{0} \\ 1 \end{array}$$

5 in base 10 is 101 in base 2.

**Example 4:**

Convert 140 (base 10) to base 8

This is the same process as before:

$$\begin{array}{r} 8 \overline{) 140} \quad 17 \text{ R } 4 \\ \underline{136} \phantom{0} \\ 4 \text{ R } 1 \\ 8 \overline{) 17} \phantom{0} \\ \underline{16} \phantom{0} \\ 1 \text{ R } 2 \\ 8 \overline{) 2} \\ \underline{0} \\ 2 \end{array}$$

140 in base 10 is 214 in base 8.