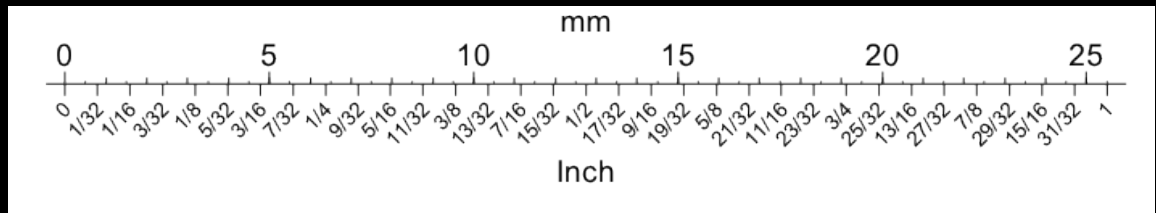


Significant Figures

“I don't think those digits mean what you think they mean”

- Inigo Montoya

“Sig Figs”



Measurements of any physical quantity are limited in precision.

The digits that are known to be correct are called the “significant” figures (often abbreviated as “sig figs”)

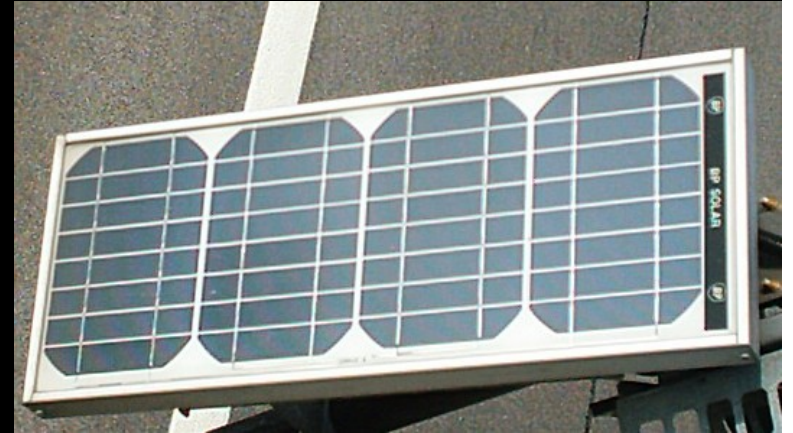
It is important to keep track of the “sig figs” in a calculation, and a calculator cannot do all the work.

There are two competing goals:

1. To compute as exactly as possible
2. To be truthful about the limitations of your input data

Addition and Subtraction

Suppose you want to measure the length of a solar panel, but it's a little longer than 1 meter. You can't use a meter stick, so you do it in steps:



1. Using a meter stick, measure from one end to a particular mark: 0.95 m
2. Using a more precise ruler from the mark to the other end: 7.56 cm
which is 0.0756 m

Adding $0.95 + 0.0756$ on a calculator yields 1.0256 meters

But that first measurement was only accurate to 2 places past the decimal, so we have to round the result to

1.03 meters

? digits

When you write a number you stop at the digits you don't know.
But we can show them by writing "?" in place of a blank.

$$\begin{array}{r} 0.95??? \\ + 0.0756? \\ \hline = 1.0256? \\ \\ = 1.03??? \\ \\ = 1.03 \end{array}$$

When you add the digits, treat "?" as zero.

But after they have been added, any column containing a "?" should not be trusted.

But we don't truncate, we round, to get to the closest number with the right number of trusted digits past the decimal

The rule for Addition (and subtraction)

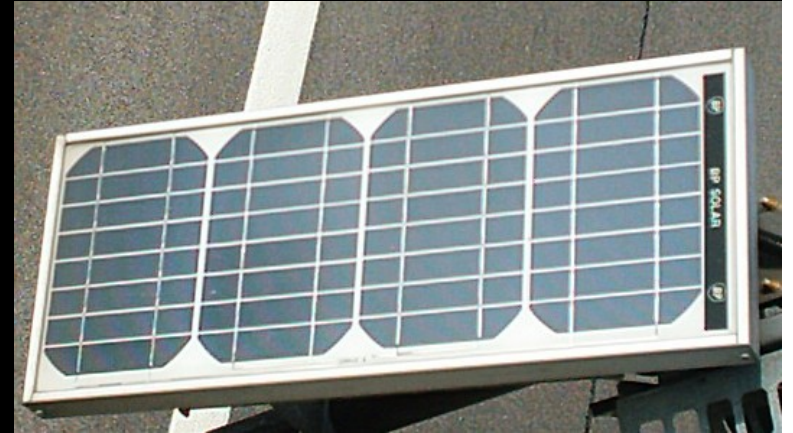
When adding or subtracting, perform the operation as usual, but restrict your result by rounding to the smallest number of *digits past the decimal* in any operand.

Multiplication and Division

Suppose you want to know the area of the solar panel.

With a long ruler you measure the width to be

$$61.7 \text{ cm} = 0.617 \text{ m}$$



Multiplying 1.03×0.617 on a calculator yields 0.63551 m^2

In this case both numbers have only 3 known digits, so the result cannot have any more than that. Again we round to get

0.636 m²

? digits

$$\begin{array}{r} 1.03?? \\ \times 0.617? \\ \hline \\ = 0.618??? \\ + 0.0103?? \\ + 0.00721? \\ \hline \\ = 0.63551? \\ = 0.636??? \\ = 0.636 \end{array}$$

Again treat ? as a digit

Perform the multiplication digit by digit, treating “?” as zero.

Any column containing a “?” should not be trusted.

But we don't truncate, we round, to get to the closest number with the right number of trusted digits.

In this case we count just digits, not digits past the decimal point.

The Rule for Multiplication (and division)

When multiplying or dividing, perform the operation as usual, but restrict your result by rounding to the smallest number of *digits from the beginning of the number* in any operand.

Summary of The Rules for Sig Figs

1. Use as many digits as possible in *intermediate* calculations, but round to the appropriate number of “sig figs” for the final answer.
2. When adding or subtracting, perform the operation as usual, but restrict your result by rounding to the smallest number of *digits past the decimal* in any operand.
3. When multiplying or dividing, perform the operation as usual, but restrict your result by rounding to the smallest number of *digits from the beginning of the number* in any operand.