Significant figures

Significant figures (or digits) explain the precision of a measurement. If a measurement does not have any digits that are zero, then all of the digits are significant. For example, the nails length of 6.36 cm has three non-zero digits, and therefore three significant figures. However, the digit zero can be significant or not depending on how it is used. Below is a method for determining what zeros are significant. The rules at the bottom of the table summarize how to determine if a zero is a significant digit

Ruane's method for determining significant figures (sig figs):

1. Underline the first non-zero number.
2. Ask yourself: Self, is there a decimal?

Yes.	NO
The underlined number plus all numbers to the right including zeros count. Example #1 102.050 6 sig figs Example #2 0.030 2 sig figs Example #3 0.1 1 sig fig	Underline the last non-zero number. **Every** number underlined and in between, including zeros count. Example #1 102 3 sig figs Example #2 30030 4 sig figs Example #3 3000 1 sig fig
1. Zeros to the left of the first non-zero number are never significant with or without a decimal. 2. Zero's that are sandwiched in-between whole numbers are always significant. 3. Zero's to the right of whole numbers are only significant when there is a decimal.	

What if a zero is significant to the right of a non-zero number without a decimal?

The measurement 2300 km has no decimal point in it, so the precision is where the rightmost integer is, or the

hundreds place. **2300 km This number has 2 sig figs**

For the measurement $23\bar{0}0$ km, there is no decimal point but there is a line over the tens place, so the measurement is precise to the tens place. This number has 3 sig figs. The line explains that the 0 is significant when a decimal point cannot be used.

PLACE CHART

Hundred Thousands	Ten Thousands	thousands	hundreds	tens	ones	decimal point	tenths	hundredths	thousandths	ten thousandths	hundred thousandths	millionths
3	4	5	6	7	8	.	0	9	8	7	6	5

Multiplying or dividing significant figures

Rule: When you multiply or divide significant figures, your answer must contain the same number of significant figures as the number with the lowest number of significant figures.

Example #1

2 sig figs 4 sig figs 2 sig figs
11 x 2.111 = 23.211 final answer = 23

You must round using the previous number.

Example #2
2sig figs 3 sig figs 2sig figs
3.6 x 8.23 = 28.805 final answer = 29

Above you only needed 2 sig figs as underlined, but you must round appropriately using the previous number.

Adding or subtracting significant figures

Rule: When you add significant figures, your answer cannot be more precise than the least precise measurement.

You answer will contain the same number of decimal places as the number with the least number of places in the decimal portion.

Example #1

10.312+ 5.20 =15.51

The least precise measurement is to the hundredths place so you answer can only go to the hundredths place.

Another view of this process. Line up the decimal points and add like you were taught in math.

10.312
+5.21
=15.522

The farthest decimal in the answer (thousandths place) cannot be in the answer because the number 5.21 did not contain a number in the thousandths place.

Final answer is 15.52

You still must round !!!!!! for example

Example #2

10.317
+ 5.21
=15.527

In this example you do not use the 7, due to the place rule, but it still effects the number 2. You must round the 2 up to 3.

Final answer is ……

15.53

Example #3 Tricky…

300
+15
315

The hundreds place is the least precise measurement in 300. Therefore, our answer must be rounded to the hundreds place.

Final answer is….
300

When you don't need to count significant figures:

Conversion Factors, Counting and Constants

The following should not determine the number of significant figures are in your answer.

Earlier in this chapter, you learned how conversion factors are used to change one unit to another. These **conversion factors** usually do not have any uncertainty. For example, there are exactly 100 centimeters in a meter. If you were to use the conversion factor 100 cm/m to change meters to centimeters, the 100 would not limit the degree of certainty in the answer.

A **counting measurement** is also exact. For example, suppose you have 10 test tubes, each containing 5.67 mL of a liquid. The number 10 is exact. It should not limit the number of significant figures in your answer. For example

, you can safely report that you have 10 times 5.67 mL, or a total of 56.7 mL of liquid.

Constants such as π = 3.14159…….. should not determine the significant figures in your answer.

Finally, significant figures should be determined at the end of a multistep calculation. Not for each step.

SUPER FUN! NOW LET'S PRACTICE!