Significant Figures

The **Significant Figures** of a number refer to those digits that have *meaning in reference to a measured or specified value*. Correctly accounting for Significant Figures is important while performing arithmetic so that the resulting answers accurately represent numbers that have computational significance or value.

There are three rules that are used to determine how many significant figures are in a number. There are also rules for determining how many digits should be included in numbers computed using addition/subtraction, multiplication/ division, or a combination of these operations.

A. Rules for determining how many Sig Figs are in a number:

Rule #1:   *Non-Zero digits (# 1 – 9)* and *Zeros that are <u>in between</u> two non-zero digits* are <u>always</u> significant.
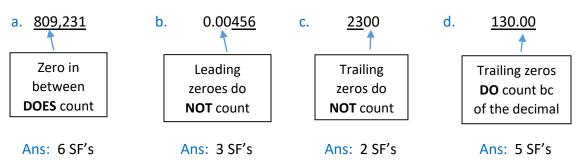
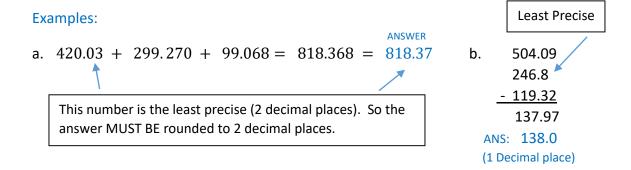Rule #2:   *Leading zeroes* are <u>never</u> significant.

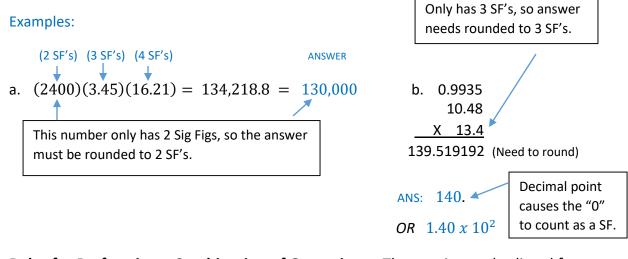Rule #3:   *Trailing zeroes* are <u>only significant if a decimal point is present</u> in the number.

Examples:

a. <u>809,231</u>

| Zero in between **DOES** count |

Ans: 6 SF's

b.   0.00<u>456</u>

| Leading zeroes do **NOT** count |

Ans: 3 SF's

c.   <u>23</u>00

| Trailing zeros do **NOT** count |

Ans: 2 SF's

d.   <u>130.00</u>

| Trailing zeros **DO** count bc of the decimal |

Ans: 5 SF's

B. Rules for performing Addition / Subtraction: The final answer is written so that it has the *same number of decimal places as the <u>measurement that has the fewest decimal places (i.e. the number that is the least precise)</u>*.

Examples:

a. $420.03 + 299.270 + 99.068 = 818.368 = $ **818.37** ← ANSWER

| This number is the least precise (2 decimal places). So the answer MUST BE rounded to 2 decimal places. |

b.
| Least Precise |

$$504.09$$
$$246.8$$
$$-\ 119.32$$
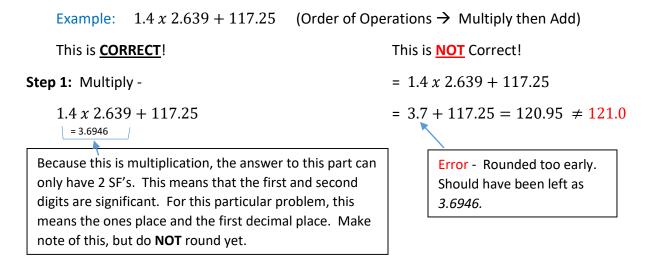$$\overline{137.97}$$

ANS: **138.0**
(1 Decimal place)

C. **Rules for performing Multiplication / Division:** The final answer is written so that it has the *same number of Sig Figs as the measurement with the fewest SF's.*

Examples:

(2 SF's) (3 SF's) (4 SF's)   ANSWER

a. $(2400)(3.45)(16.21) = 134{,}218.8 = $ 130,000

This number only has 2 Sig Figs, so the answer must be rounded to 2 SF's.

Only has 3 SF's, so answer needs rounded to 3 SF's.

b. 0.9935
    10.48
  X 13.4
  ‾‾‾‾‾‾‾
  139.519192 (Need to round)

ANS: 140.

OR 1.40×10^2

Decimal point causes the "0" to count as a SF.

D. **Rules for Performing a Combination of Operations:** The previous rules listed for A/S and M/D still apply along with incorporating the rules for order of operations (*i.e. PEMDAS*). Be cautious, however, that you **do not round the answer too early**!

Example: $1.4 \times 2.639 + 117.25$ (Order of Operations → Multiply then Add)

This is **CORRECT**!   This is **NOT** Correct!

Step 1: Multiply - $= 1.4 \times 2.639 + 117.25$

$1.4 \times 2.639 + 117.25$ $= 3.7 + 117.25 = 120.95 \neq 121.0$
   │= 3.6946│

Because this is multiplication, the answer to this part can only have 2 SF's. This means that the first and second digits are significant. For this particular problem, this means the ones place and the first decimal place. Make note of this, but do **NOT** round yet.

Error - Rounded too early. Should have been left as *3.6946.*

Step 2: Addition -

= 3.6946 + 117.25 = 120.9446 = 120.9 (Correct Answer)

1 decimal place   2 decimal places

Answer needs to be rounded to 1 decimal place because that is the least precise number in the addition calculation.

Note - Conversion Factors are considered to be "perfect" quantities and are <u>not</u> used to determine the number of sig figs / decimal places in the calculated answer.