

Significant Figures

There are two main rules for **significant figures** in the final answer:

1. \times / \div Multiplication/Division Rule

Significant figures in the final answer are limited by the number **having the *fewest*** significant figures.

Example:

$$2.157 \times 5.1 = 11.0007 \Rightarrow 11$$

4 2 6 2 in the final answer

Significant Figures

2. $+$ $-$ Addition/Subtraction Rule

Significant figures in the final answer are limited by the number with the ***fewest*** significant figures ***on the right side of the decimal point***.

Example:

$$2.1548 + 2.1 - 0.158 = 4.0968 \Rightarrow 4.1$$

4 1 3 4 1 in the final answer

Significant figures after the decimal point

3. Internal zeros are significant figures.

Example: $1.001 \Rightarrow 4$ significant figures.

4. Leading Zeros are NOT significant figures:

Example: $0.\underbrace{00000000}_{\text{not significant}}1001 \Rightarrow$ Still only 4 significant figures.

5. **Trailing Zeros may or may not be significant figures.** That is why we need to be careful when we are looking at the number. If the number is said to be **measured with the trailing zeros, then the zeros are significant figures.** If the zeros are added unnecessarily, say by a careless mistake, then they are not significant figures.

Example: **Measured** $1.0010 \Rightarrow 5$ significant figures.

Mistake $1.0010 \Rightarrow 4$ significant figures.

Significant Figures

More Examples:

$$1. \quad \frac{(1.002 + 1.1)}{0.333} = \frac{2.1}{0.333} = 6.3$$

Since we are *adding* in the numerator, we first use the Addition Rule and find that there is only one significant figure in the numerator. So the result in the numerator is 2.1. Then we divide the two numbers (using the Division Rule). Since 2.1 has only two significant figures, so does the answer.

2.

$$\begin{aligned} & \frac{(4.00 + 8.0) \times 5.12 \pi + 1.2 \times 10^2}{1.3} = \frac{(12.0) \times 5.12 \pi + 1.2 \times 10^2}{1.3} \\ & = \frac{193. + 1.2 \times 10^2}{1.3} = \frac{313.}{1.3} = \\ & = 2.4 \times 10^2. \end{aligned}$$

Notice we are **not** taking into consideration **constants** like π to determine significant figures.

When we have a number times ten to a power, we look only at the significant figures of the number in front of the ten, not including the ten or the power as significant figures. Thus in adding $193. + 1.2 \times 10^2$, the 193. has no significant figures after the decimal point and 1.2×10^2 has one significant figure after the decimal, so the sum 313. has no significant figures after the decimal.

3. We measured the radius of a circle as 33.27 meters. To find the circumference, we use the formula $C = 2\pi r$. The significant figures come only from the radius, the only measured value. The constants '2' and the ' π ' do not determine significant figures, so the answer has four significant figures.

$$C = 2\pi (33.27) = 209.0$$