

Significant Digits

A significant digit (figure) is one that has been measured with certainty or has been properly estimated.

Think using a 30 cm ruler with mm markings ^{1mm is the least count} and you record the following measurement:

Probably should be written as 7.95 cm
 7.96 cm
 ↑ guessed

7.9567321985 cm
 ↑ certain digits
 ↑ guess or estimate

* When counting significant digits, we count the certain digits and the one uncertain digit (guessed or estimated)

Examples

203.4 cm ~> 4 sd least count 1cm
 certain ↑ uncertain estimated 0.1cm

4.07 cm ~> 3 sd least count 0.1cm
 certain ↑ uncertain estimated 0.01cm

What about zeros?

$14.002 \text{ cm} \rightsquigarrow 5 \text{ sd}$
certainty uncertain
 $60.2 \text{ cm} \rightsquigarrow 3 \text{ sd}$

A zero is always significant if it is between non-zero digits

$29.20 \text{ cm} \rightarrow 4 \text{ sd}$
 $7.020 \text{ cm} \rightarrow 4 \text{ sd}$

A zero is significant if it is to the right of the decimal and a non-zero digit

not significant (place holders)
 $0.00517 \text{ cm} \rightarrow 3 \text{ sd}$
uncertain
 $5.17 \times 10^{-3} \text{ cm}$

leading zeros never count as significant digits

$25000 \text{ m} \rightsquigarrow 2 \text{ sd}$ (we really don't know)

trailing zeros are not significant (unless after a decimal point)

$2.5 \times 10^4 \text{ m} \rightsquigarrow$ definitely 2sd

$2.50 \times 10^4 \text{ m} \rightsquigarrow$ definitely 3sd

$2.500 \times 10^4 \text{ m} \rightsquigarrow$ definitely 4sd

$2.5000 \times 10^4 \text{ m} \rightsquigarrow$ definitely 5sd

depends on the least count (a precision) of the measuring instrument

NOTE: Some older books:

25000 m
 $25000. \text{ m}$

} 5sd

Rules For Significant Digits

Digits from 1-9 are always significant.

Zeros between two other significant digits are always significant

One or more additional zeros to the right of both the decimal place and another significant digit are significant.

Zeros used solely for spacing the decimal point (placeholders) are not significant.