

## Significant Digits

When recording a measurement you should usually try to record 1 digit past the least count digit.

You have to make a guess as to what that digit is.

This last digit that you record is called the uncertain digit

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

Consider using a 30 cm ruler with mm marking (least count is 1 mm or 0.1 cm) and you record the following measurement:

15. ~~3278915829~~ cm

↑ uncertain digit  
↑ least count place

you cannot make this guess at the rest of the digits  
(you can only have 1 uncertain digit)

More reasonable measurements {

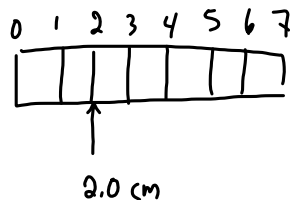
15.33  
15.32  
15.34

← certain   ← uncertain

This measurement has 4 significant digits  
(3 certain + 1 uncertain)

So when counting significant digits, you count ALL certain digits and the ONE uncertain digit.

\* No matter how precise your measuring instrument, you will always have to make a guess about the last digit that you record. No measurement is exact!



Examples

least count place value (1g)  
 $203.\underline{4}$  g  $\rightsquigarrow$  4sd  
 certain  $\uparrow$  uncertain  
 least count place value (0.1cm or 1mm)  
 $4.0\underline{7}$  cm  $\rightsquigarrow$  3sd  
 certain  $\uparrow$  uncertain

What about zeroes?

$14.\underline{00}2$  km  $\rightsquigarrow$  5sd  
 $60.2$  cm  $\rightsquigarrow$  3sd

Any zero between non-zero digits is significant.

$29.\underline{20}$  m  $\rightsquigarrow$  4sd

$7.\underline{050}$  g  $\rightarrow$  4sd

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

leading zeros are not significant

$0.\underline{000}581$  m  $\rightarrow$  3sd  
 certain

$5.81 \times 10^{-4}$  m  $\rightarrow$  3sd

leading zeros are never significant

$3500$  m  
 ?

As this is written, we cannot tell what the uncertain digit is or what the least count of the measuring instrument is.

This is better expressed in scientific notation:

$3.5 \times 10^3$  m  $\rightarrow$  2sd (LC 1000m)  
 $3.50 \times 10^3$  m  $\rightarrow$  3sd (LC 100m)  
 $3.500 \times 10^3$  m  $\rightarrow$  4sd (LC 10m)

When you write 3500m, this could have 2, 3 or 4 sig digs. It is ambiguous to use trailing zeroes + better to use scientific notation.

As a general rule, we do not count trailing zeroes as significant unless after a decimal point

$3500.0$  m  $\rightarrow$  5sd

some older books:

$3500.$   $\rightarrow$  4sd

$350\bar{0}$   $\rightarrow$  4sd

$20^\circ\text{C}$   
 $15^\circ\text{C}$