Significant Digits

Regardless of how precise the measuring instrument, no measurement is exact and always involves a guess.

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

You have to make a guess as to what the last digit is that you record. → this last digit is called the uncertain digit because you have made a guess

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

Consider a 30 cm with (mm) markings and you record the measurement to be: ← 1mm is the least count.

15.27859278519 2 cm ← impossible to write this if using mm as your least count

↑ least count place

↑ need to guess about this digit.

A better measurement to record would be:

15.28 cm

15.27 cm → 4sf

Certain ↑ Uncertain

* When counting significant digits in a measurement, you count all the certain digits and the ONE uncertain digit.

Examples

203.4 cm → 4 sd (LC = 1 cm)

certain digits. ↑ uncertain digit

4.07 cm → 3 sd (LC = 1 mm or 0.1 cm)

certain digits ↑ uncertain digit

What about those zeroes?

14.002 cm → 5 sd
60.2 cm → 3 sd

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

29.20 cm → 4 sd
7.020 cm → 4 sd

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

0.08517 cm

leading zeroes are not significant

⇒ 8.517×10^{-2} cm

leading zeroes are never significant.

25000 m ← The problem with writing a measurement like this is that we do not know how precise the measuring instrument is (LC = 10,000 m OR 1000 m OR 100 m OR 10 m)

If we don't know how precise, then we take the least precise value.

HOW DO YOU KNOW WHAT THE LEAST COUNT IS?

25 000 m ← place holders

certain digit ↑ uncertain digit

2 sd

Some older textbooks use: 25000. m (5 sd)
25000̄ m (5 sd)

A better way to show significant digits:

2.5×10^4 m → 2 sd (LC = 10,000 m)

certain ↑ uncertain

2.50×10^4 m → 3 sd (LC = 1000 m)

certain uncertain digit

2.500×10^4 m → 4 sd (LC = 100 m)

2.5000×10^4 m → 5 sd (LC = 10 m)

Trailing zeroes are not significant (unless you know more about the precision of the measuring instrument).

What about 370.00 mm → 5 sd.

There are some things we don't need to worry about for significant digits.... they are exact numbers.

- counting numbers (52 pennies)
- conversions... 1 m = 100 cm
  1 ft = 12 in
- numbers in formulas:
  $A = \frac{1}{2}bh$

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.