

SIGNIFICANT FIGURES

<http://www.csun.edu/~hcchm001/IntroChemHandouts.html>

	Number ¹	Significant Figures
1. All digits (1-9) are significant	1.589 m	4
	0.897 m	3
	3600 m	2 ²
2. Significant Zeroes		
a. All sandwiched zeroes	13.02 m	4
	1.0002 m	5
	10.5 m	3
b. All trailing zeroes preceded by a digit	0.0200 m	3
	15.0 m	3
3. Nonsignificant Zeroes		
a. Leading zeroes	0.0200 (2.00 x 10 ⁻²) m	3
b. Trailing zeroes to left of decimal in a number without decimal part	360 (3.6 x 10 ²) m	2 ²
	56,000 (5.6 x 10 ⁴) m	2 ²

NOTES: ¹ Write numbers in exponential notation if you have any doubt; any zeros used to indicate the power of 10 (order of magnitude) are not significant. Note that nearly all numbers have units associated with them. These must always be written with the number.

² For these types of numbers, the zero could be counted as a significant digit if the number results from a measurement or a calculation. See rules on the next page ($K = ^\circ C + 273 = 37 + 273 = 4.50 \times 10^2$ K, for 3 significant figures). Numbers in science usually result from measurements and calculations in the laboratory.

ROUNDING OFF

1. If the last digit to be retained in a number is followed by a number <5, ROUND DOWN.

Round to 3 significant figures: 28.23 g rounds to 28.2 g
578.1 g rounds to 578 g

2. If the last digit to be retained in a number is followed by a number >5, ROUND UP.

Round to 2 significant figures: 5.998 cm rounds to 6.0 cm
0.00258 cm rounds to 0.0026 cm
3.6502 cm rounds to 3.7 cm

3. If the last digit to be retained in a number is followed by 5 (0000000...implied), ROUND UP if the digit to be retained is ODD (1,3,5,7,9) but ROUND DOWN if the digit to be retained is EVEN (0,2,4,6,8)

Round to 2 significant figures: 1.75 g rounds to 1.8 g (7 is odd)
1.050 g rounds to 1.0 g (0 is even)
1.45 g rounds to 1.4 g (4 is even)

Round to 4 significant figures: 67.835 g rounds to 67.84 g (3 is odd)
67.885 g rounds to 67.88 g (8 is even)

UNCERTAINTY AND SIGNIFICANT FIGURES

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THE LEAST ACCURATE NUMBER (LAN) DETERMINES THE NUMBER OF DIGITS TO WHICH THE ANSWER IS EXPRESSED

MULTIPLICATION AND DIVISION

ADDITION AND SUBTRACTION

- a) The LAN is the number one with the least number of decimal places. The answer (SUM or DIFFERENCE) can have not more decimal places than the LAN.

EXAMPLE:

212 g water (LAN)
2.1 g salt
1.88 g sugar

215.98 g (incorrect)

216 g (correct)

- b) If a number has no decimal places, the LAN is the number with the fewer digits *and* with the last digit in the highest place.

EXAMPLE:

3600 mL water (LAN)
111 mL ethanol
55 mL isopropyl alcohol

3766 mL (incorrect)

3800 mL (correct)

- c) Zeros may be counted as significant digits if they are the result of a calculation in which the calculated zero is in a place that is known by the numbers used in the addition or subtraction.

EXAMPLE: Convert 37 °C to K

$$\begin{aligned} K &= ^\circ\text{C} + 273 \\ &= 37 + 273 \text{ (both known in ones place)} \\ &= 4.50 \times 10^2 \text{ K} \\ &= 450. \text{ K (notation less commonly used)} \end{aligned}$$

- a) The LAN is the number with the least number of significant figures.
- b) The answer (PRODUCT OR QUOTIENT) can have no more significant figures than the LAN.

EXAMPLE:

Calculate the volume of a rectangular solid that has a length of 4.16 cm, a width of 2.2 cm, and a height of 2.00 cm.

$$\begin{aligned} \text{Volume} &= \text{length} \times \text{width} \times \text{height} \\ &= (4.16 \text{ cm})(2.2 \text{ cm})(2.00 \text{ cm}) \\ &= 18.304 \text{ cm}^3 \quad \text{(incorrect)} \\ &= 18 \text{ cm}^3 \quad \text{(correct)} \end{aligned}$$

PRACTICE PROBLEMS

1. Give the number of significant figures:

- 9.9099 m
- 0.9090 m
- 0.0909 m
- 9×10^{-3} m

2. Express your answer to the proper number of significant figures:

- $99.099 \text{ g} + 1.91 \text{ g} =$
- $3.33 \times 10^{-2} \text{ cm} - 1.45 \times 10^{-3} \text{ cm} =$
- $15.15 \text{ cm} \times 2.10 \text{ cm} =$
- $0.516 \text{ cm}^3 / 1.0301 \text{ g/cm}^3 =$
- $83.15 \text{ m} / (9.0 \times 10^2 \text{ m}) =$
- $K = 177 ^\circ\text{C} + 273 =$