STUDY TIPS

PME1.7: RULES FOR SIGNIFICANT FIGURES

In scientific measurements, significant figures are used to indicate the accuracy of a measurement. The last digit in a measurement is often an estimate, a good guess.

All the digits in a measured value, including the last estimated digit, are called significant figures or significant digits.

Consider a series of measurements made with (a) an old wooden ruler without mm marks, (b) a more accurate steel ruler, (c) steel callipers with a Vernier scale.

	Reported Result	Number of Significant Figures in the measurement	Accuracy of measurement	Implied range of possible values
(a)	7 cm	1	To the nearest 1 cm, ie 7 ± 0.5 cm	6.5 cm – 7.5 cm
(b)	7.2 cm	2	To the nearest 0.1 cm, ie 7.2 ± 0.05 cm	7.15 – 7.25 cm
(c)	7.23	3	To the nearest 0.01 cm, ie 7.23 ± 0.005 cm	7.225 – 7.235 cm

The number of Significant Figures in a measured value

Rule 1 Any non-zero digit is significant. The position of a decimal point makes no difference.

Example 1			
	15.7	3	sig. figs
	157	3	sig. figs
	1.57	3	sig. figs
	2.7942	5	sig. figs

Rule 2 Zeros between numbers **are** significant.

Example 2			
	1.05	3	sig. figs
	10.51	4	sig. figs
	200.708	6	sig. figs

Rule 3 Zeros at the right hand end of whole numbers are **not** significant, unless otherwise stated.

Example 3	70	1	sig. figs
	2860	3	sig. figs
	15090	4	sig. figs

Rule 4 Zeros at the left hand end of decimal numbers are **not** significant.

Example 4	0.28	2	sig. figs
	0.0039	2	sig. figs
	0.0604	3	sig. figs

Rule 5 Zeros at the right hand end of decimal numbers **are** significant.

Example 5	12. 0	3	sig. figs
	0.760	3	sig. figs
	0.48300	5	sig. figs
	2.07090	6	sig. figs

Significant Figures and Scientific Notation

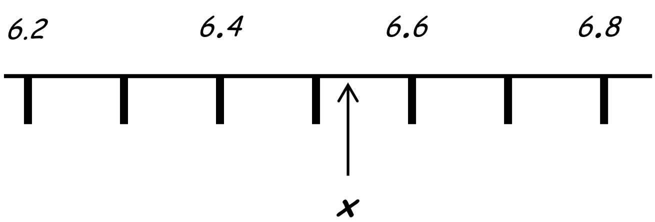
The problems of deciding how many significant figures a value has is simplified by writing its value in Scientific Notation.

Examine the number of digits in the first number below, not in the power of ten.

(a)	$0.0003 = 3 \times 10^{-4}$	1 sig fig	Rule 4
(b)	$720000 = 7.2 \times 10^{5}$	2 sig figs	Rule 3
(c)	$660 = 6.6 \times 10^{2}$	2 sig figs	Rule 3
(d)	$660.0 = 6.600 \times 10^{2}$	4 sig figs	Rule 5
(e)	$0.66000 = 6.6000 \times 10^{-1}$	5 sig figs	Rule 5
(f)	$808.01 = 8.0801 \times 10^{2}$	5 sig figs	Rule 2

Recording measurements and Significant Figures

Consider the scale below.



The measurement x is:

- Certainly greater than 6 and less then 7
- Certainly greater than 6.5 and less than 6.6
- Very probably greater than 6.53 and less than 6.55

The result would be recorded as 6.54 - a value with 3 significant digits. The first two digits are certain and the last is a good estimate.

Writing "6.54" implies "6.54 ± 0.005", ie between 6.535 and 6.545, unless otherwise stated.

Exercise

Write each of the following measurements in Scientific Notation and state the number of significant digits in the value.

(a)	345	(b)	17642	(c)	0.0033	(d)	0.000306
(e)	870	(f)	20000	(g)	140.600	(h)	710.0
(i)	0.04080	(j)	0.0050				

Answers

Exercise

(a)	345	3.45×10^2	3 sig figs
(b)	17642	1.7642×10^4	5 sig figs
(c)	0.0033	3.3×10^{-3}	2 sig figs
(d)	0.000306	3.06×10^{-4}	3 sig figs
(e)	870	8.7×10^2	2 sig figs
(f)	20000	2×10^4	1 sig fig
(g)	140.600	1.40600×10^2	6 sig figs
(h)	710.0	7.100×10^2	4 sig figs
(i)	0.04080	4.080×10^{-2}	4 sig figs
(j)	0.0050	5.0×10^{-3}	2 sig figs