Significant Figures and Scientific Notation

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1 Significant Figures

Significant figures are a shorthand for the precision of a measured or reported value: they include all certain digits plus one estimated digit. Practical rules: all non-zero digits are significant; zeros between non-zeros are significant (101 has 3); leading zeros are not (0.00101 has 3); trailing zeros are significant only if a decimal point is present or the precision is made explicit otherwise. A common framework to deal with all these cases is the scientific notation introduced in the next section.

2 Scientific Notation

In the scientific notation we represent numbers with powers of 10. For example, $10.4 = 1.04 \cdot 10^1$or $1234.56 = 1.23456 \cdot 10^3$. Let's test the scientific notation with the cases for the significant figures that we came across in the previous section. We agreed that 101 has 3 significant figures. We can write this number in scientific notation as $101 = 1.01 \cdot 10^2$and we read off 3 significant figures as well. The other example was 0.00101 also with 3 significant figures, in agreement with the scientific notation, $0.00101 = 1.01 \cdot 10^{-3}$. But how do we deal with trailing zeros? Here is the difficulty: 100 may have 1, 2, or 3 significant figures and it is impossible without further context to distinguish the three cases. Now, let's investigate the three cases in the scientific notation: $100 = 1.00 \cdot 10^2$with three significant figures, $100 = 1.0 \cdot 10^2$with 2 significant figures and $100 = 1 \cdot 10^2$with 1 significant figure. Therefore, the scientific notation has removed any ambiguity in determining significant figures.

3 Exercises

- How many significant figures has 1234.567?
- How many significant figures has 1234?
- How many significant figures has 10000? 10001?