Preparations for A-Level Physics

Sanjin Zhao

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Learning Outcome

I highly recommend you to finish this checklist to determine whether you've achieved the leanring objectives.

- ☐ Grasp *Scientific Notation*
- ☐ Read and count significant figures
- ☐ *Mathematic Rules* for sig fig calculations
- ☐ Do *Rounding* of values

Leadin

You know $\pi \approx 3.141592653589793238\ldots$, to how many decimal places do we need to achieve a satisfying value? Let's talk about the *significant figures*[1]

[1] def

Scientific Notation

I think you would grasp all in scientific notation, let's jsut skip this section.

Significant Figures

The number of significant figures in a result is simply the number of figures that are known with some degree of reliability. The number 13.2 is said to have 3 significant figures. The number 13.20 is said to have 4 significant figures.

Rules for counting

There are several rules for deciding the number of significant figures in a value. They are listed below:

1. All nonzero numbers are significant
   - 1.234 has _ sig fig
   - 22,112,133.565 has _ sig fig
   - 3.5678×10^8 has _ sig fig
2. Zeroes between nonzero digits are significant:
   - 1002 kg has _ sig fig
   - 3.07 mL has _ sig fig
3. Zeroes to the left of the first nonzero digits are not significant; such zeroes merely indicate the position of the decimal point[2]:
   - 0.001 °C has _ sig fig
   - 0.001 A has _ sig fig
4. Zeroes to the right of a decimal point in a number are significant:
   - 0.002 00 m has _ sig fig
   - 1.002 00 m has _ sig fig
5. When a number ends in zeroes that are not to the right of a decimal point, the zeroes are not necessarily significant:
   - 190 g has 2 sig fig
   - 190.0 g has 3 sig fig

   Think, what makes the difference?
6. any exact value or scientific constant has **infinitely many** sig figs
   - π
   - our class consist of 21 students

[2] think scientific notation

Mathematics Rules

The general rule is that the accuracy of a calculated result is limited by the least accurate measurement involved in the calculation[3].

In addition and subtraction, round by the least number of decimals. For example, 100. (assume 3 significant figures) + 23.643 (5 significant figures) = 123.643, which should be rounded to 124 (3 significant figures).

In multiplication and division, the result should be rounded off so as to have the same number of significant figures as in the component with the least number of significant figures. For example, 3.0 (2 significant figures) 12.60 (4 significant figures) = 37.8000 which should be rounded off to 38 (2 significant figures).

There are some further rules:

1. **Logarithm** (log**,** ln) uses the input's number of significant figures as the result's number of decimals.
2. **Exponentiation** (n^x) only rounds by the significant figures in the base, which is the sig fig of n.

Rounding Off

1. If the digit to be dropped is greater than 5, the last retained digit is increased by one
2. If the digit to be dropped is less than 5, the last remaining digit is left as it is
3. If the digit to be dropped is 5, and if any digit following it is not zero, the last remaining digit is increased by one
4. If the digit to be dropped is 5 and is followed only by zeroes, the last remaining digit is increased by one if it is odd, but left as it is if even[4].
5. the simpliest statement of rounding is ' round to the nearest thousandth decimal places'

Task

count the sig fig each and calculate the result thereof rounding to the correct sig fig .

076.0128076×02000
$1123.20 \times 2000.$
$(61.29 \times 10^7) \times (12.01 \times 10^6)$ $(5.7 + 12.26) \times 3.11$
$64450 + 1$
$64450.0 \div 1.0$

[3] You can use this website to verify your answer

[4] This rule means that if the digit to be dropped is 5 followed only by zeroes, the result is always rounded to the even digit. The rationale is to avoid bias in rounding: half of the time we round up, half the time we round down