GOOD SCIENTISTS RESPECT THEIR GRANDPARENTS AND SIGNIFICANT FIGURES

Rules for Significant Figures(Digits) adopted from:
http://www.physics.uoguelph.ca/tutorials/sig_fig/SIG_dig.htm

The number of significant figures in an answer to a calculation depend on the number of significant figures in the given data, as discussed in the rules below.

When are Digits Significant?

Non-zero digits are always significant. Thus, 22 has two significant digits, and 22.3 has three significant digits.

With zeroes, the situation is more complicated:

a. **Leading Zeros,** zeros placed before other digits are not significant; 0.046 has two significant digits.
b. **Captive Zeros**, zeros placed between other digits are always significant; 4009 kg has four significant digits.
c. **Trailing Zeros**, zeros placed after other digits but behind a decimal point are significant; 7.90 has three significant digits.
d. Zeroes at the end of a number might not significant if they are not behind a decimal point. Otherwise, it is impossible to tell if they are significant. For example, in the number 8200, it is not clear if the zeroes are significant or not. The number of significant digits in 8200 is at least two, but could be three or four. To avoid uncertainty, use scientific notation to place significant zeroes behind a decimal point:

8.200×10^3 has four significant digits

8.20×10^3 has three significant digits

8.2×10^3 has two significant digits

e. Note that whole numbers have essentially an unlimited number of significant digits. The numbers in balanced chemical equations are whole numbers.

f. When using molar masses, use at least as many sig figs as there are in all other measurements. For instance, if all measurements have at least 3 sig figs, for H's molar mass of 1.00797 we can use 1.01 (3SF) but not 1!

MOST IMPORTANT RULE Significant Digits in Multiplication, Division, Trig. functions, etc.

In a calculation involving multiplication, division, trigonometric functions, etc., the number of significant digits in an answer should equal the least number of significant digits in any one of the numbers being multiplied, divided etc.

Example:

Thus in evaluating sin(kx), where k = 0.097 m^{-1} (two significant digits) and x = 4.73 m (three significant digits), the answer should have two significant digits.

Note that whole numbers have essentially an unlimited number of significant digits. As an example, if a hair dryer uses 1.2 kW of power, then 2 identical hairdryers use 2.4 kW:

1.2 kW {2 sig. dig.} ´ 2 {unlimited sig. dig.} = 2.4 kW {2 sig. dig.}

Significant Digits in Addition and Subtraction

When quantities are being added or subtracted, the number of *decimal places* (not significant digits) in the answer should be the same as the least number of decimal places in any of the numbers being added or subtracted. But if calculations also involve multiplication or division, the multiplication rule takes priority.

Example:

5.67 J (two decimal places)
1.1 J (one decimal place)
0.9378 J (four decimal place)
7.7 J (one decimal place)

Only apply the sig fig rules once in a problem, at the end of all the steps. For in-between answers, just keep them in your calculator and on paper report the in-between answers with at least 1 extra sig fig.

Try these Exercises:

1. 2.7^{kt} = ?, where k = 0.0189 yr^{-1}, and t = 25 yr.
2. ab/c = ?, where a = 483 J, b = 73.67 J, and c = 15.67
3. x + y + z = ?, where x = 48.1, y = 77, and z = 65.789

Answers

1. 1.6
2. 2.27 $X10^3$
3. 191 (we don't use the multiplication rule; when there's only +/-, we go by the least number of decimal places; see above)