Significant Digits vs Rounding

When a problem asks you to round to certain number of decimal points, most people are familiar enough with the procedure to do so. For example, if you were asked to round 347.56702 to the nearest hundredth, you would find the hundredths place (347.56702), look at the number that follows and determine if you should round up or leave the number as is. In this case, the 7 that follows our 6 is greater than or equal to 5 (half of ten, the base of our numbering system) so we would round up to 347.57 and be finished. This might also be phrased as 'round to the nearest two decimal places.'

There is a difference however, when asked to round to two significant digits. The number 347.56702 rounded to two significant digits would be 350. This is a very different result from that of the first paragraph. A significant digit is:

- All nonzero digits.
- All zeroes between significant digits.
- All zeroes which are both to the right of the decimal point and to the right of all nonzero significant digits.

Say what? In our previous example, 350 has two significant digits as the three and the five are significant. (This would be the same as rounded to the nearest ten.) The zero that trails the five is not significant. However, 350. has three significant digits as the decimal indicated a level of precision to the nearest unit, making the zero significant. Similarly, 350.0 has four significant digits.

Going back to our original number, 347.56702 we could round to:

- Three significant digits to get 348
- Four significant digits to get 347.6
- Five significant digits to get 347.57
- Six significant digits to get 347.567

- Seven significant digits to get 347.5670 (notice the trailing zero after the decimal is significant, it indicates a level of precision)
- Eight significant digits to get 347.56702
- Nine significant digits to get 347.567020, and so on.

In dealing with small values, such as 0.0000381, we find only three significant digits (the 3, the 8 and the 1). The leading zeroes here are only indicating size. While they are to the right of the decimal, they do NOT follow any significant digits so they are not significant. The number 0.000038100 now has five significant digits as the two zeroes at the end are significant (to the right of the decimal AND following significant digits).

Significant digits, or significant figures, are used frequently in the sciences to express precision in your calculations. If you have measured one value to the nearest tenth, with three significant digits, and another value to the nearest hundredth, with four significant digits, then your solution could only be completely accurate to three significant digits; the smallest of the values originally measured. That is, you cannot measure the length and width of a floor to the nearest inch and then express the area with accuracy to the nearest eighth of an inch. You can only be as precise as your original data.

Practice Problems: Round each value to (a) the nearest ten, (b) the nearest tenth, (c) the nearest hundredth, (d) two significant digits, (e) three significant digits, and (f) four significant digits.

1) 12,935.0038	2) 94.993	3) 24.1956
4) 649.3802	5) 46.10102	6) 500.003

Practice Problem solutions

1) 12,935.0038
    a. 12,940
    b. 12,935.0
    c. 12.935.00
    d. 13,000
    e. 12,900
    f. 12,940
2) 94.993
    a. 90
    b. 95.0
    c. 94.99
    d. 95
    e. 95.0
    f. 94.99
3) 24.1956
    a. 20
    b. 24.2
    c. 24.20
    d. 24
    e. 24.2
    f. 24.20
4) 649.3802
    a. 650
    b. 649.4
    c. 649.38
    d. 650
    e. 649
    f. 649.4
5) 46.10102
    a. 50
    b. 46.1
    c. 46.10
    d. 46
    e. 46.1
    f. 46.10
6) 500.003
    a. 500
    b. 500.0
    c. 500.00
    d. 500 (5.0×10^1, scientific notation is helpful here)
    e. 500 (5.00×10^2, scientific notation again is helpful here for clarity)
    f. 500.0