Chemistry Lecture #9: Addition, Subtraction, Multiplication and Division of Significant Figures.

Rules for rounding numbers

Suppose we want to round a set of numbers to three significant figures. Here's how to do it:

1. If the digit to the immediate right of the last significant figure is less than five, do not change the last significant figure.

   2.732 → 2.73

2. If the digit to the immediate right of the last significant figure is greater than five, round up the last significant figure.

   2.736 → 2.74

3. If the digit to the immediate right of the last significant figure is equal to five and followed by a nonzero digit, round up the last significant figure.

   2.7351 → 2.74

   2.735002 → 2.74

4. If the digit to the immediate right of the last significant figure is equal to five and is not followed by a nonzero digit, look at the last significant figure. If it is an odd digit, round it up. If it is an even digit, do not round up.

   2.7350 → 2.74 since 3 is an odd number and we round it up to 4.

   2.7650 → 2.76 since 6 is an even number and we leave it alone.

Addition, subtraction, multiplication and division.

Suppose I want to measure the mass of some coins, and I have two scales. I put some of the coins on one scale, and the rest of the coins on the other scale. I'll measure the two quantities and add them up to get the total mass of the coins.

The first scale can measure tiny quantities as small as 0.01 g. The second scale can only measure things as small as 1 g.

Here are the masses measured on each scale, and their sum.

1st scale: 18.75 g
2nd scale: + 44 g
62.75 g

Can we say that the sum is really 62.75 g? Nope. The problem is that the second scale can't measure quantities as small as 0.01 or even 0.1 g. The mass of coins on the second scale could be 44.00 g, or 44.05 g, or 44.86 g. We have no idea what the two digits past decimal could be.

Since we don't know the value of the two digits past the decimal on the 2nd scale, it means we also don't know the value of the digits past the decimal when we add the two quantities. We cannot write 62.75 g since we don't know if the last digits are .75.

Since we have no idea what the last two digits past the decimal could be, we can't write any digits past the decimal in the final answer. We have to look at the answer, then round to the smallest quantity that can measured by our worst scale. Our worst scale can only measure things as small as 1 g, so we round to the one's digit.

1st scale: 18.75 g
2nd scale: + 44 g
62.75 g rounded to the one's digit = 63 g

When adding or subtracting significant figures, the answer must be rounded to the least number of decimals.

5.34
9.3
+ 6.12
20.76 → 20.8

7.524
- 4.31
3.214 → 3.21

24
+ 18.4
42.4 → 42

13.5×10^8
$+ 24.3 \times 10^7$ →
13.5×10^8
$+2.43 \times 10^8$
15.93×10^8
15.9×10^8
Or 1.59×10^9

When multiplying or dividing, the number of significant figures in the answer cannot exceed the fewest number of significant figures in the problem.

Seven S.F. Four S.f. Four S.F.

$(49.60000\ g) \div (47.40\ mL) = 1.046413$ → $1.046\ g/mL$

Three S.F. Seven S.F. Three S.F.

$1.13\ sec \times 51.26122\ m/sec = 57.9251786$ → $57.9\ m$

Four S.F. Three S.F.

$11.25\ ft \times 0.00630\ ft = 0.070875$

↓

Three S.F.

7.0875×10^{-2} → $7.09 \times 10^{-2}\ ft^2$