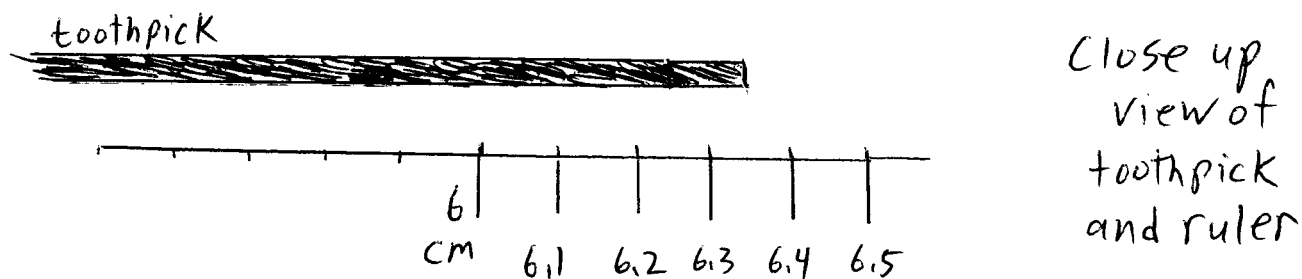


Chemistry Lecture #7: Significant Figures

Significant figures are the number of digits in a measurement. For example, the measurement 3.52 g has three significant figures, while the measurement 3.5 g has two significant figures. The more significant figures in a measurement, the more precise the measurement.

The number of significant figures you can record in a measurement depends on what you can see when you use a measuring instrument. For example, suppose we measure the length of a toothpick with a ruler.



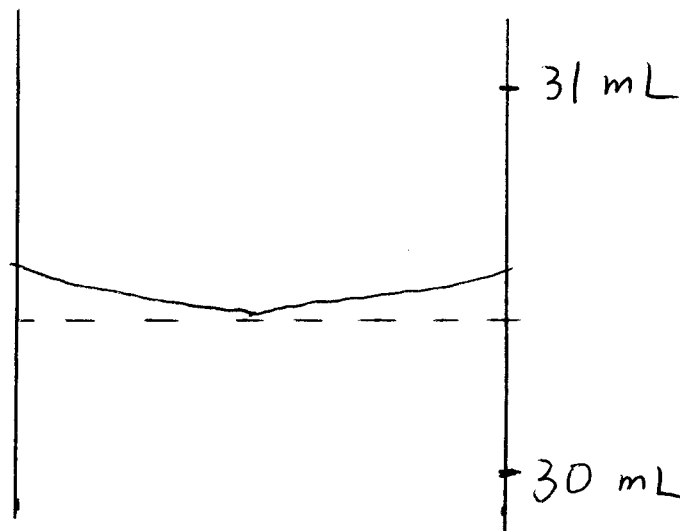
Notice that the length falls between 6.3 and 6.4 cm. We shouldn't write 6.3 because we can see it is more than 6.3, and we shouldn't write 6.4 because we can see it is less than 6.4. We can see that it is *probably* half-way between 6.3 and 6.4, so we can write down 6.35 cm. The last digit, "5" is an estimate. We can clearly see that the length is at least 6.3 cm. Thus, we write the numbers we can definitely see, and we tack on the last number as an estimate we can see.

When you see measurements like 4.3 g, 56 m, or 504.21 L, the first digits you see are known/observed, and the last digit on the right is an estimated digit.

When the lines on a measuring instrument are close together like they are on a ruler marked in millimeters, it can be difficult to estimate the last digit. All you can see is that the measurement is in between the lines. You can't tell if it is closer to one line or another. If a measurement falls between two lines that are really close together, the best estimate is that it is half-way in between, and the estimated digit is 5 (since the measurement is 50% in between the lines).

But if the spacing is large enough, we can see if a measurement is closer or further from a line. We can estimate the last digit with other numbers besides 5.

For example, suppose I'm measuring the volume of water with a graduated cylinder. The spacing between the lines on the cylinder is larger than the spacing on the ruler.



Notice the volume of the water falls between 30 and 31 mL. Since it is at least 30 mL, our first two digits are 3 and 0. What about the last estimated digit? To me, it looks like it is just short of being halfway between 30 and 31, so I'll write it as 30.4 mL.

If the water was-

just past 30, I'd write 30.1.

1/4 between 30 and 31, I'd write 30.2.

1/3 between 30 and 31, I'd write 30.3.

just short of being half way, I'd write 30.4.

halfway across, I'd write 30.5.

just past the halfway point, I'd write 30.6.

2/3 between 30 and 31, I'd write 30.7.

3/4 between 30 and 31, and I'd write 30.8.

just short of 31, I'd write 30.9.

Even if you use a measuring device with a digital display, the last digit in the display is still an estimate. For example, a digital kitchen scale may measure the mass of a block of cheese as 121.24 g, but the last digit "4" is an estimate because it could change to a "5" or "3" if temperature and wind currents affect the instrument. We won't know which digit is correct - we write down "4" and estimate that it is probably correct.