

Observation Sheet

ROUNDING, RATIOS, AND PERCENTS

Rounding

Stopwatches typically measure things to the nearest 0.01 seconds. Hopefully the discussion we had about errors will convince you that your timings will not be that accurate. Therefore, your times should be rounded appropriately. Similarly, your calculations should be rounded appropriately, so that you don't exaggerate the precision of your data.

If you are familiar with the rules of significant figures (a.k.a. significant digits), apply those rules to your calculations. If you are not familiar with those rules, here are the relevant rules:

Mentally convert your measurement to scientific notation. For example, in the above sample calculation, 265.96 would be 2.6596×10^2 . Similarly, 0.034567 would be 3.4567×10^{-2} . Both of these numbers have 5 "significant figures" because five numbers were written in front of the power of ten. Exact numbers (e.g. the 60 in "60 arcminutes in a degree") have an infinite number of significant figures.

When you multiply or divide, your final answer should have the same number of significant figures as the least precise number that you multiplied/divided. For example, if you multiply 264 (3 significant figures) and 1345.2 (5 significant figures), your final answer would be 355132.8 if you did not round. But here, you should round your answer to 3 significant figures, or 355000 (better written as 3.55×10^5) because 264 only had 3 SFs.

The reason you round the above number is because you only know that the final answer is around 355000. Your data (specifically the 264 part of your data) cannot distinguish between, for instance, 355010 and 3549990, because you weren't able to measure 264 very precisely.

So we round our final answers to express not only our best guess at the value of the calculation, but also the appropriate level of precision of the calculation.

Ratios

To compute a ratio of two things, for instance the height-to-weight ratio, take the first data (height) and divide it by the second (weight). Ratios are useful to determine relative sizes. For example, computing the ratio of Jupiter's radius (71500 km) to Earth's radius (6380 km) tells us that Jupiter is $71500/6380 = 11.2$ times larger than Earth. There will be many times in the lab class where it will be useful to take the ratio of two numbers to compare their relative sizes. The ratio will usually fit in with other properties of the data.

Percents

Percents are usually calculated as differences between two numbers. For instance, Jupiter's radius is 71,500 km and Saturn's radius is 60,300 km. Jupiter is 11,200 km bigger than Saturn. Therefore Saturn is $11,200/71,500 \times 100\% = 15.6\%$ smaller than Jupiter, or Jupiter is $11,200/60,300 \times 100\% = 18.6\%$ bigger than Saturn. Notice that in the first percent calculation, since we were comparing Saturn TO Jupiter's size, we divided by Jupiter's size, while in the second example, since we were comparing Jupiter TO Saturn, so we divided by Saturn's size.

Percent errors

To compute the percent error, you probably know the absolute error of a measurement. For example, let's say you know that you measured a time of 95.3 seconds, but that you can only time things accurately to within 0.2 seconds due to reaction time and other things. Therefore, your measurement of 95.3 seconds is $0.2/95.3 \times 100 = 0.2\%$ accurate. That's actually pretty accurate. Most measurements in this class will be around 5% accurate, when you account for all of the things that can go wrong!

Final Words

These are fairly mathematical subjects, so see me if you're having trouble doing the relevant computations in the lab. The few minutes you spend learning this will pay off, both in your lab score and overall in life, when you can apply these ideas elsewhere.