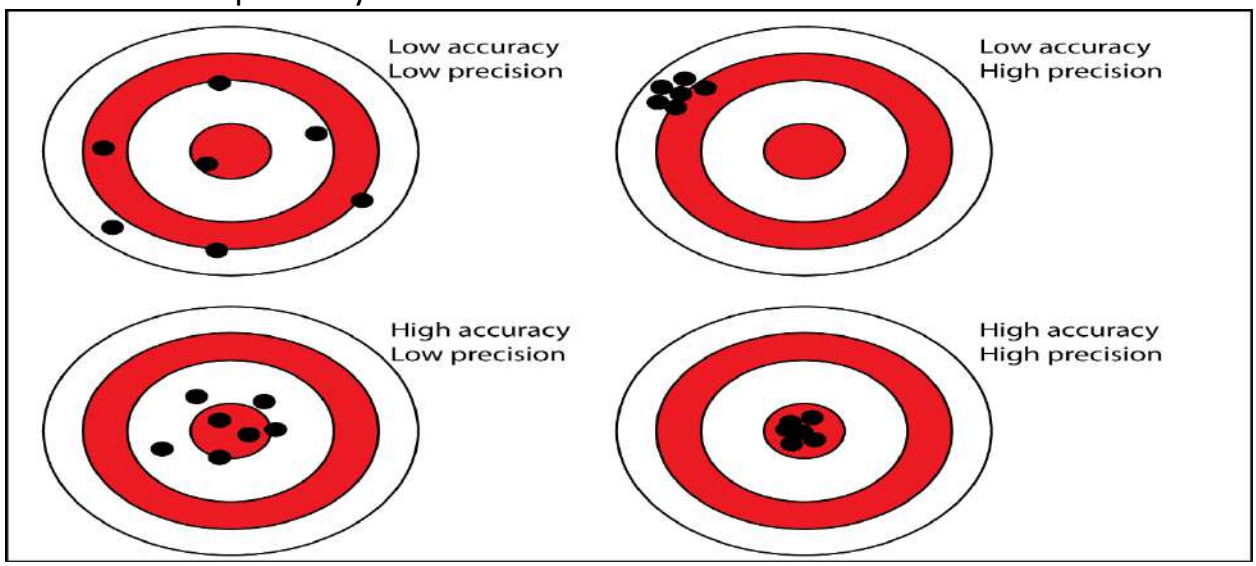
Significant figures (sig figs)

1. When measuring with some device, sometimes the object and the marks on the device do not quite match up. You may need to guesstimate that last digit. This creates a slight amount of doubt as to the correctness or *accuracy* of the measurement.

2. Sig figs are used to eliminate as much doubt as possible from a measurement. Sig figs are numbers that are *precise* - very carefully measured and reproducible. Because they are very carefully measured, they should be accurate. BUT if the measuring device is off, the measurement will be off no matter how precise you are.



3. Rules for determining if a number is significant.

a. Any nonzero is significant – 1, 2, 3, 4, 5, 6, 7, 8, 9. EX. The value of **123** has 3 sig figs. This is true b/c if you wrote down a number such as the 2 in 123, it's b/c it was a number seen on the measuring device. The value is not 133. It's not 113. It was measured as 123.

b. Any zero between 2 nonzero is significant. EX. The value of 1**00**2 has 4 sig figs. This is true b/c if you wrote down the 2 zeros in 1002, it's b/c it was a number seen on the measuring device. The value is not 102. It's not 12. It's not 1102. It was measured as 1002. If you hadn't measured the zero, you wouldn't have recorded it.

c. Any zero in front of a decimal by itself is not significant. EX. The value of **0**.12 has 2 sig figs. The value of **0**.12342 has 5 sig figs. The zero was not measured. It is used as a place holder for the decimal. If you rewrote the value as .12 or .12342, it doesn't make it a better measured number.

d. Any zero behind a number that is behind decimal is significant. It is called a trailing zero. EX. The value of 0.12**0** has 3 sig figs. The 2nd zero (trailing zero) was measured. That trailing zero tells you the value of the thousandths place. That zero means that the value is not 0.121. It's not 0.122. If you rewrote the value as .12, it doesn't change the value, but as 0.12 it is a less precisely measured number. Would you rather a doctor prescribed 0.120 grams or 0.12 grams? The 0.120 is a better measured number with the zero, so that makes that trailing zero a sig fig.

e. Any zero behind a decimal, in front of a nonzero is not significant. EX. The value of 0.**0**12 has 2 sig figs. The value of 0.**000**12 has 2 sig figs. The zero after the decimal acts just as a place holder for the 1 and 2. The number could be rewritten as 1.2×10^{-2} or 1.2×10^{-4}

f. Zeros at the end of a number are not significant if there is not a decimal behind the zero. EX. The value of 12**0** has 2 sig figs. The value of 13**000** has 2 sig figs

g. Zeros at the end of a number are significant if there is decimal behind the zero. EX. The value of 12**0.** has 3 sig figs. The value of 13**000.** has 5 sig figs

h. In rules f. and g., the decimal is being used to signify whether the trailing zero was measured or not. Without a decimal, the zero is considered to be unmeasured. The measurement written as 120 means *about* 120. It could be 119 or 121, but you're not sure so you go with about 120 When you record the number as 120., that means that the value is *definitely*, *exactly* 120. b/c it was measured as such with a zero after the 1 and the 2.

4. Rules for calculations follow the spirit of "the answer cannot be a better measurement that the parts."

a. For addition and subtraction – Perform the addition or subtraction. Round the answer to the shortest decimal placing of the original measurements.

EX. 23.4 + 456.789 = 480.189 BUT since the 23.4 was only measured out to the tenth placing, the final answer can only be recorded to the tenth placing. So, the 480.189 needs to be rounded to 480.2 The numbers before the decimal are irrelevant. Addition and subtraction rules are concerned only with reconciling the numbers **after** the decimal.

b. For multiplication and division – Perform the function. Round the answer to the least number of sig figs in the original measurements. EX. 0.123 X 45.6789 = 5.6185047 BUT since the 0.123 only has 3 sig figs while the 45.6789 has 6, the final answer can only be recorded using 3 sig figs. So, the 5.6185047 needs to be rounded to 5.62 Multiplication and division rules are only concerned with **how many** sig figs there are. The placing of the decimal is irrelevant.