

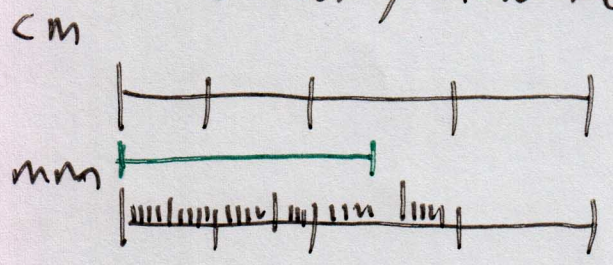
precise, but not accurate

accurate, but not precise

accurate and precise

accuracy - how close is a measurement to the true or accepted value

precision - how close are measurements to each other; how reproducible are the results



- In terms of instrumentation, precision is how many significant (meaningful)

digits does the instrumentation give,

$$\% \text{ error} = \frac{\text{measured value} - \text{accepted value}}{\text{accepted value}} \times 100\%$$

% error is a measure of accuracy average (mean)

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

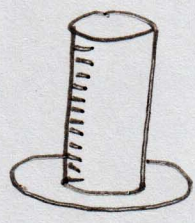
Types of glassware



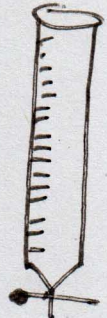
beaker



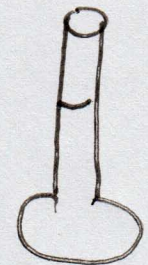
Erlenmeyer flask



graduated cylinder



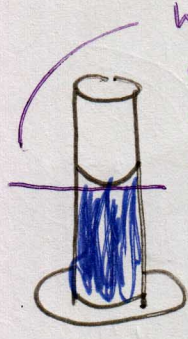
buret



volumetric flask

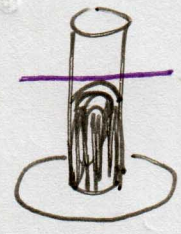
25.00 mL

increasing precision + accuracy →

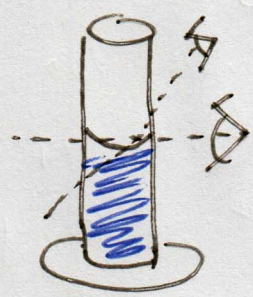
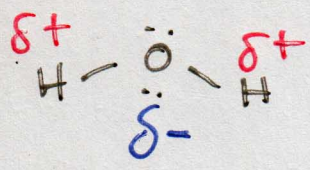


When a meniscus curves down, volume is measured at the bottom of the meniscus. meniscus - a curve on the surface of a liquid due to the interaction of that liquid with a container

H₂O



If the meniscus curves up, the volume is measured at the top of the meniscus.



parallax - If the eye level is not even with the meniscus, the wrong volume of liquid will be measured due to the incorrect viewpoint.

Significant figures (sig figs)

0.00370 ← 3 sig figs

Leading zeros (ignored)

If a number begins with a decimal point, every digit after and including the first non-zero digit is significant.

274.30 ← 5 sig figs

If a number has a decimal point in the middle (or end), every digit is significant.

addition/subtraction

$$\begin{array}{r} 10.73 \\ 110.00 \\ + 5.7467 \\ \hline 126.4767 \end{array}$$

when reading from left to right, when any number runs out of digits, the last digit is the last one kept in the answer.

⇒ 126.48

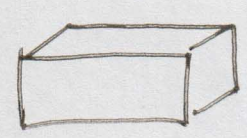
If the next digit after the last one kept is 0-4, the number is rounded down, if it is 5-9, the number is rounded up.

multiplication / division

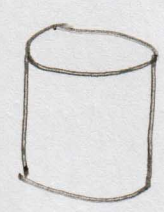
$$\begin{array}{r}
 10.74 \leftarrow 4 \text{ sig figs} \\
 8.1 \leftarrow 2 \text{ sig figs} \\
 \hline
 1074 \\
 85920 \\
 \hline
 86.994 \Rightarrow 87.
 \end{array}$$

whichever number being multiplied (or divided) has the least number of sig figs, that is the number of sig figs kept in the answer.

density = $\frac{\text{mass (g)}}{\text{volume (mL)}}$ accepted density of water @ 25°C = 0.997 g/mL



volume = length x width x height



radius (r) = diameter / 2

Volume = $\pi r^2 h$