Measurement and data processing

Uncertainties in calculated results

- *In addition and subtraction: Add absolute uncertainties*
- *In multiplication, division and powers: Add percentage uncertainties*
- *If one uncertainty is much larger than the others, ignore the other uncertainties and estimate the uncertainty based on the larger one using the rules above.*

Uncertainty and error in measurement

Random uncertainties (or errors) arise mostly from inadequacy or limitation in the instrument or the way a measurement is made. Random errors make a measurement less precise, but not in any particular direction. These are written as an uncertainty range, such as 44.20 ± 0.05 cm3.

Systematic errors are due to identifiable causes, and arise from flow in the instrument or errors made in taking a measurement such as an incorrect calibration of a pH meter or reading the top rather than the bottom of the meniscus. Systematic errors always affect a result in a particular direction (always smaller or larger) unlike random errors. Random uncertainties can be reduced by repeating readings; systematic errors can not reduced by repeating readings.

Precision

If an experiment is repeated many times, the precision is a measure of how close the repetitions will be to each other. The precision or reliability of an experiment is a measure of the random error. If the precision is high then the random error is small.

Accuracy

The accuracy of a result is a measure of how close the result is to some accepted or literature value Accuracy is a measure of the systematic error. If an experiment is accurate then the systematic error is very small.