

Chemists should concern themselves with the reliability of their measurements. Ideally their measurements are both correct (accurate) and reproducible (precise).

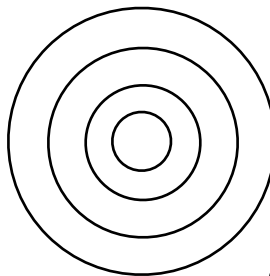
Accuracy is a measure of how close a measurement/calculation comes to the theoretical (true/accepted) value.

Precision is a measure of how close a series of measurements are to one another. Precision reflects the reproducibility of a given type of measurement.

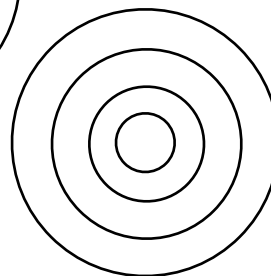
Imagine throwing darts at a dartboard on which you are aiming for the bulls-eye.

Sketch a set of 4 or 5 darts that would reflect each of the three situations below.

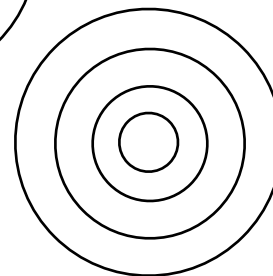
A. good accuracy and good precision



B. poor accuracy yet good precision

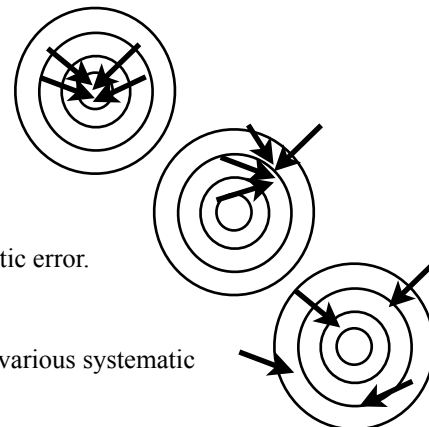


C. poor accuracy and poor precision



Random Error vs Systematic Error

- *Random error* (also called indeterminate error) means that a measurement has an equal probability of being high or low. Statistical analysis or averaging can usually reduce random error. Since all measurements have some degree of uncertainty, all measurements have some amount of random error.
 - ✓ Example: You measure the mass of a ring three times using the same balance and get slightly different values: 17.46 g, 17.42 g, 17.44 g
- *Systematic error* (also called determinate error) is associated with some flaw in the equipment or design of an experiment. Systematic errors, unlike random errors always shift the results in the same direction, either always high or always low. Systematic errors are much harder to detect than random errors because even when they occur, the data “appears” to be good.
 - ✓ Example: The cloth tape measure that you use to measure the length of an object had been stretched out from years of use. (As a result, all of your length measurements were too small.)
 - ✓ or The electronic scale you use reads 0.05 g too high for all your mass measurements (because it is improperly tared throughout your experiment).



ANSWERS

A. Accurate and precise - represents very little random error and no systematic error.

B. Not accurate but precise - represents very little random error but large systematic error.

C. Not accurate and not precise – represents large random error and perhaps various systematic errors (but not just one systematic error)