Experimental Errors

Measurements:

Two questions that an experimentalist needs to keep in mind when performing measurements.

1. "How good or accurate is the numerical results?"
   ⇨Uncertainty attached to a result ($P \pm \delta P$)

2. "How good does it need to be?"
   It will determine how much resources will be needed to design or redesign the experiment.

3 steps to answer these two questions:

a) **Step 1.** Before performing the experiment. A propagation of errors method is used. It will predict the approximate size of the errors ➔ $P \pm \delta P$, where δP is the uncertainty. This will tell you which measurements contribute the most to the uncertainty.
   Useful when ask to design or redesign an experiment.

b) **Step 2.** During the experiment. Acquire enough data points (8 to 10) to allow statistical analysis (calculation of average and standard deviation (*e*)).

c) **Step 3.** After the experiment. Compare results

1) e with δ and if $\delta >> e$ then some sources of error need to be added to the propagation of error.

2) Your result with literature value. If $|X_{exp} - X_{lit}| >> 2e$ then systematic errors were made that could be procedural or computational.

3) Relative error = $|X_{exp} - X_{lit}| / X_{lit} \sim 1\%$ accepted up to 5%.