Most important things for you to know in Taylor:

1. Compatibility: The whole point of quantitative measurement with uncertainties is to test hypotheses, and compare results.

o Sections 2.4 and 2.5, that is: you measure q, and you compare it to p. Define the discrepancy D = q – p.

They are **compatible** if

$|D| = |q - p|$ is less than the uncertainty of this difference, typically $\sqrt{(\delta q^2 + \delta p^2)} = \delta D$ or just δq if p is a very well known theoretical value so δp is tiny or zero

a slightly more generous criterion compares it with δq + δp (the worst case): this is just "do the error bars touch"

More generally, describe the degree of discrepancy in terms of the number of standard deviations away from expectations:

$Z = |D| / \delta D$ when δD is a standard deviation of |D| .

2. **Know the Uncertainty Calculation Formulae on inside covers**. (As of Exp1, up through page 75)

Example of q = x/y uncertainty calculation: x = 10 δx = .1 y = 2.7 δy = .2

Often easiest to do in terms of %

$\delta q/q = \sqrt{(1\% + 8\%)} \approx 8\%$ so $\delta q \approx .08\times q \approx .3$

For q = x ± y, x, y, q, dx, dy, dq same units (will want to add q + dq, e.g. as error bars)

δq/q, δx/x, δy/y all have NO UNITS (can write as a fraction, or as %, but watch the factor of 100!)

Whip out your calculator: try r=10 dr = .1δr/r = 1%

say $q = r^2$ then δq/q = ? Let's calculate directly :

$(q + \delta q)/q = (r+\delta r)^2 / r^2 = 102.01/100 = 1.0201 = (q + \delta q) / q$, so δq/q = 2.01%

compare Eq 3.23, 3.26: $\delta q / q = (|dq/dr|\ \delta r) / r^2 = 2\ \delta r / r = 2\%$ (identical as $\delta q \to 0$)

q = x + y always must have:

$\delta q > \max(\delta x , \delta y)$

q = x*y or x/y $\delta q/q > \max(\delta x/x, \delta y/y)$]

Independent measurement: no relationship in the *imperfections* between the measurements; e.g. 2 students measure the same distance each with a different, but good, ruler. A measurement dominated by a systematic error (same shrunken ruler used by both students) would produce results that aren't independent. See chapter 4.

Random: you expect to get slightly different values each time you measure it: due to reading uncertainties, varying judgments, uncontrollable factors, or inherent properties of the measurement.

Lab Notebook Hints I gave my sections (your TA will comment if he prefers different procedures):

- Homework and calculations are to be done independently. Ideally, you each have your own data.
- If you don't understand the readings, make an appointment with your TA; best before the first lab; 2nd best between. Remember, it can turn up on the quiz.
- Purpose of reading and homework is to prepare you for lab; purpose of quiz is a highly-visible reward. Do your homework BEFORE the lab, not just before you turn in your report.
- All data, all measurement techniques go into lab book: blogging your procedure.
- When you quote your uncertainty, give the reason you estimate that uncertainty. It is often **larger** than how finely you can read the instrument.
- Show at least the formula you intend to use for each type of calculation. Far better is one example sketched out with numbers so we can tell whether you are using the formula correctly; otherwise all we can do is mark you wrong, not point to problems.
- If your lab notebook allows it, turn in the originals, not the copies: MUCH easier to read.
- Make tables to summarize, so both you and we can get the big picture! Tables and graphs are the best ways for you to see if your data makes sense. Eg.

	δx	L	W	H	M (g)	V	Density	Material
Ruler	.1	1.5	2.0	1.3	100.0 ± .1	3.9 ± .4	2.5 ± .3	Aluminum (density 2.7)
Caliper	.01		etc					

(all lengths in cm; volume and δV in cm^3; density and δDensity in g/cm^3)