Advanced Lab homework set 6

From Taylor chapter 8:

1. Problem 2: Do *not* graph this by hand or do any calculations the way Taylor says to do it. Use a computer (Mathematica, Python, or whatever) to generate the plot and calculate the curve fit. Turn in a single beautiful plot. Include an appropriate title, labeled axes, and curve-fit data on the plot.

2. Problem 5, as written.

3. Problem 7: Again, use a computer and turn in a single beautiful plot.

4. Problem 13: Use a computer as before, possibly twice with the different sets of errors bars.

5. Problem 16: Do B only, we'll do A in class.

6. Problem 18: This goes along with #5 nicely.

7. Problem 26: Don't do this the way Taylor says to do it. Instead, use a computer to do an appropriately-weighted curve fit of the data provided and turn in a single beautiful semi-log plot, with errorbars, that convincingly tells the viewer everything he/she needs to know about τ and $\delta\tau$.

8. Revisit your work on the "Wavelength of a Laser" lab. The equation for constructive interference is given by

   $$m\lambda = d\,(\cos\theta_o - \cos\theta_m)$$

   which can be re-organized as

   $$\cos\theta_m = \cos\theta_o - \left(\frac{\lambda}{d}\right) m$$

   This is "linear" equation in the form $y = A + Bx$, if you use the substitutions

   $$y \equiv \cos\theta_m \qquad x \equiv m \qquad A \equiv \cos\theta_o \qquad B \equiv -\frac{\lambda}{d}$$

   Plot an appropriate graph of this data, with errorbars. (The errorbars may vary in size, of course, even if the uncertainty in your initial measurements is constant, since the y value is actually the cosine of an inverse tangent of that initial measurement.) Do a weighted curve fit to determine λ and $\delta\lambda$. Comment on any differences between this determination of λ and the one you *probably* made earlier using $\bar{\lambda}$ and $\sigma_{\bar{\lambda}}$.