# Physics 131 Calculator Notes: OP4

Those of you with fancy calculators (such as the TI 83+) may find it helpful to prepare ahead of time by storing constants and formulas:

Constants:
Wavelength of the He-Ne Laser:

| | |
|---|---|
| 632.8E-9 STO–> W | Store the wavelength in m in "W"<br>Keep constants in m,kg,s units<br>(There's no λ on the TI-83 keypad) |
| 0.6 STO–> L | Distance from grating to scale<br>(change if your distance differs) |
| 0.01/5276 STO–> D | Diffraction grating spacing<br>(You'll change this after you measure it) |

Formulas:

press the button labelled Y= and complete the formula

| | |
|---|---|
| $Y_1=L*TAN(SIN^{-1}(X/D))$ | Calculate spectrometer scale position<br>for a given wavelength, x. |
| or | |
| $Y_1=L*X/\sqrt{(X^2- D^2)}$ | That's the same thing. |
| $Y_2=(0.5 - 1/X)^{-1}/10.9678E6$ | Balmer Series wavelength for<br>transition from level x to 2, x = 3,4,5,6. |

PART 1:

You calculate slit spacing by measuring fringes. Given that *L* is the distance between the slit plate and the screen, and the position of the *n*th fringe *y* is measured from the direct beam position, then you can find the line spacing *d* from the formula

$$n\lambda = d \sin(\theta)$$

where θ is $\tan^{-1}(y/L)$. If the angle is small then $\sin(\theta) \approx y/L$.

> Use your calculator to see if the angle is small enough that the error caused by the small angle approximation is insignificant compared to your measurement accuracy.

If the small angle approximation holds then

$d = n\lambda L/y$

otherwise $d = n\lambda/\sin[\tan^{-1}(y/L)]$.

Remember that λ is stored as W and you may need to change *L*.

PART III

Use a calculation similar to that of Part 1 to find the diffraction grating line spacing. Don't count on the labelled value to be correct. Replace the value of D with your supposedly correct value.
You will then use the stored equations to calculate the spectrometer scale and to compare your hydrogen spectrum wavelengths to the wavelengths predicted by the Balmer series transitions.
To use these equations press VAR, then -> to select FUNC, then ENTER. Press 1 for $Y_1$
On the screen $Y_1$ appears, then you can fill in the value of X (the wavelength) inside parentheses:

$Y_1$(300E-9)

The corresponding position (in m) will be calculated. To calculate the next value press 2nd ENTRY. That brings back the function so you can then change the 300 to something else.

To find the wavelength for a Balmer series transition between energy levels 3 and 1, for example, type

$Y_2$(3) the wavelength is displayed.