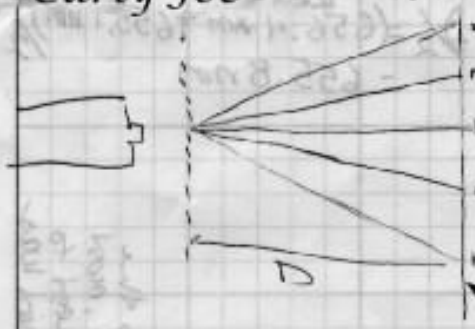
Larry, Moe, Curly Joe — Diffraction Grating and the Hydrogen Spectrum — July 5, 2010



$n\lambda = d\sin\theta$

$\lambda = 632.8$ nm

X_{1L} X_{1R} X_{2L} X_{2R}

$X_L = 35.93$ cm $X_R = 35.9$ cm

$X_{2L} = 76.84$ cm $X_{2R} = 76.8$ cm

$D = 184.7$ cm

Don't overwrite numbers

Sketch too small, messy

Color	n	X_L	X_R
red	1	35.9 cm	35.9
	2	75.8 cm	75.8

Cor $\theta_1 = \tan^{-1}\left(\frac{X_L}{D}\right) = \tan^{-1}\left(\frac{35.93\text{cm}}{184.7\text{cm}}\right) = 10.82°$

$\theta_2 = \tan^{-1}\left(\frac{X_{2L}}{D}\right) = \tan^{-1}\left(\frac{76.84\text{cm}}{184.7\text{cm}}\right) = 22.47°$

Tough to follow!

$n=1$ $d = \frac{n\lambda}{\sin\theta} = \frac{1(632.8\times10^{-9}\text{ m})}{\sin(10.82°)} = 3.371\times10^{-6}$ m

$n=2$ $d = \frac{2(632.8\times10^{-9}\text{ m})}{\sin 22.47°} = 3.311\times10^{-6}$ m

$n=1$

Color	$\bar{\theta}_R$	$\bar{\theta}_L$	θ_R (deg, min)	θ_L (deg, min)	θ_R (decimal)	θ_L (decimal)	$127.92° - \theta_R$	$129.92° - \theta_L$	$\theta = \frac{\theta_R - \theta_L}{2}$
Red	116°34'	139°14'	116.57°	139.23°			11.35°	−11.31°	11.33°
Blue-Green	119°34'	136°16'	119.57°	136.27°			8.35°	−8.35°	8.35°
Violet	120°27'	135°20'	120.45°	135.33°			7.47°	−7.41	7.44°
	127°55'		127.92°						

Need more room for table

Difficult to tell which calculations produce which results

$n=1$ $\langle d\rangle = (3.371\times10^{-6}\text{ m} + 3.311\times10^{-6}\text{ m})/2 = 3.341\times10^{-6}$ m

$\lambda_{red} = d\sin\theta =$

$n=2$

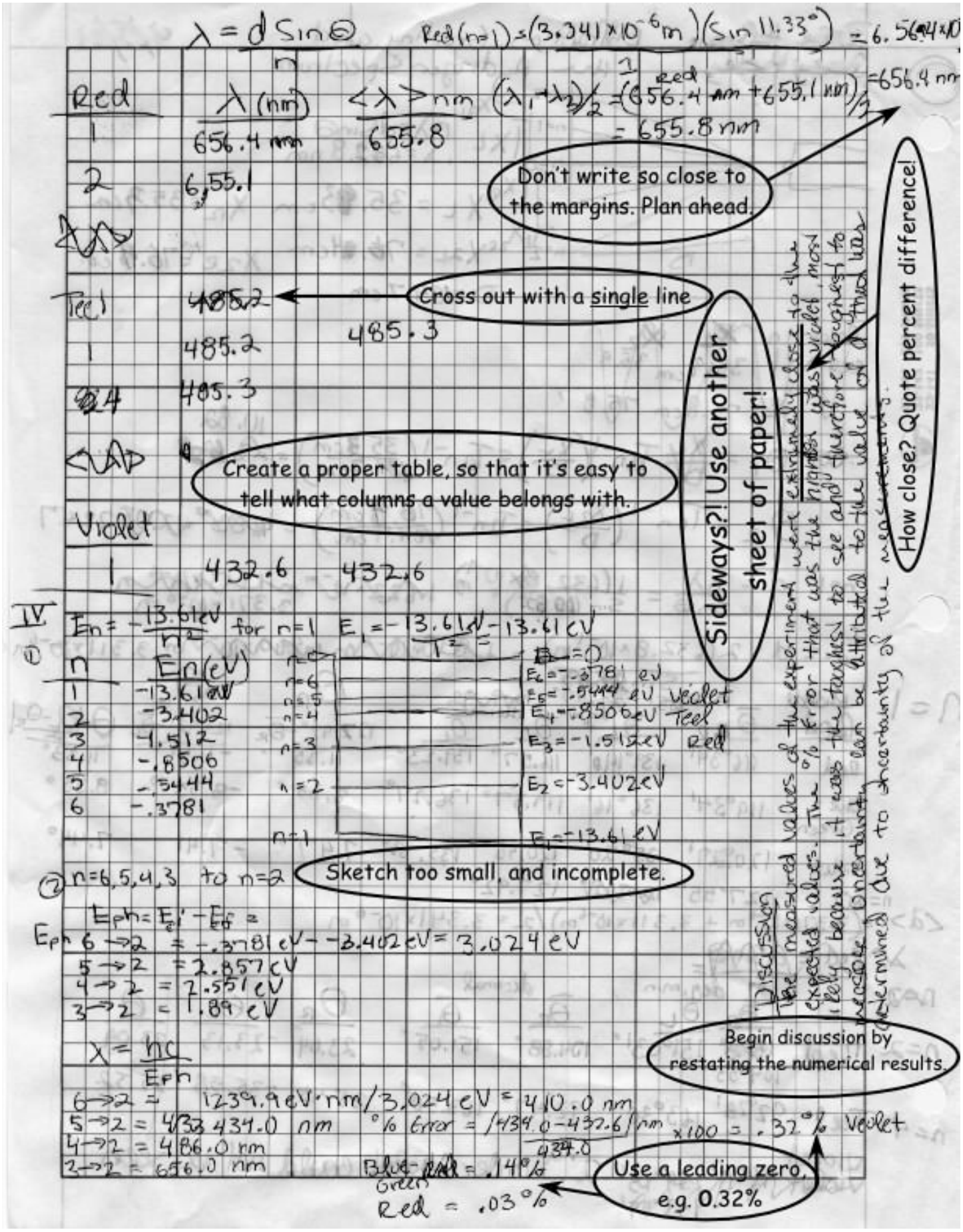
Color	$\bar{\theta}_R$	$\bar{\theta}_L$	θ_R (deg, min)	θ_L (deg, min)	θ_R (decimal)	θ_L (decimal)	θ_R	θ_L	θ
Red	104°53'	151°03'	104.88°	151.05°			23.04	−23.13	23.09
							35.45	−35.58	35.52

Leave room for corrections

$n=4$ Teal 92°28' 163°30' 92.47° 163.50°

Violet 95°49' 143°59'

Violet 2nd order Violet could not be seen


λ = d sin θ
Red (n=1) = (3.341×10⁻⁶ m)(sin 11.33°) = 6.564×10
Red
λ (nm)
<λ> nm
(λ1+λ2)/2 = (656.4 nm + 655.1 nm)/2 = 655.8 nm
656.4 nm
655.8
655.1
Don't write so close to the margins. Plan ahead.
=656.4 nm
How close? Quote percent difference!
Teel
485.2
485.3
Cross out with a single line
Create a proper table, so that it's easy to tell what columns a value belongs with.
Violet
432.6
Sideways?! Use another sheet of paper!
IV
En = -13.6 eV / n² for n=1 E1 = -13.61 eV
n
En (eV)
1 -13.61 eV
2 -3.402
3 -1.512
4 -.8506
5 -.5444
6 -.3781
E6 = -.3781 eV
E5 = -.5444 eV Violet
E4 = -.8506 eV Teel
E3 = -1.512 eV Red
E2 = -3.402 eV
E1 = -13.61 eV
n=6
n=5
n=4
n=3
n=2
n=1
② n=6,5,4,3 to n=2
Sketch too small, and incomplete.
Eph = Ef' - Ef =
Eph 6→2 = -.3781 eV - -3.402 eV = 3.024 eV
5→2 = 2.857 eV
4→2 = 2.551 eV
3→2 = 1.89 eV
λ = hc / Eph
6→2 = 1239.9 eV·nm / 3.024 eV = 410.0 nm
5→2 = 433 434.0 nm
4→2 = 486.0 nm
3→2 = 656.0 nm
% Error = |434.0 - 432.6| / 434.0 ×100 = .32 % Violet
Blue-Green = .14 %
Red = .03 %
Use a leading zero, e.g. 0.32%
Discussion
The measured values of the experiment went extremely close to the expected values. The % error that was the highest was violet, most likely because it was the toughest to see and therefore required the most subjective judgment. Uncertainty can be attributed to the value of the measurements.
Begin discussion by restating the numerical results.