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Polarization of Light

1. With the polarizers positioned such that the light meter is reading near maximum intensity, yet is not saturated, record the angle of the rotating polarizer B as the zero angle reference point.

   Zero Angle Reference = 90° ± 0.05

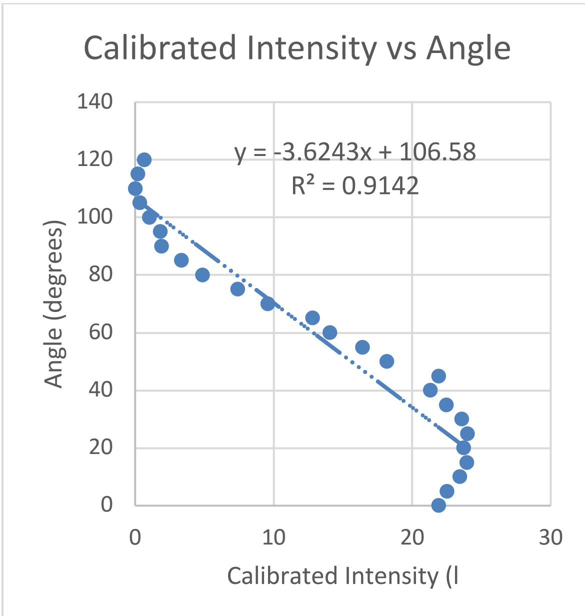
2. After continuously collecting data while adjusting the angle of the rotating polarizer B find the absolute minimum intensity. If plotting in Capstone, this would appear as the bottom of a parabola or sinusoid. Alternatively, it would be the minimum value in the datatable in Capstone. Record this minimum intensity as the background intensity reference point.

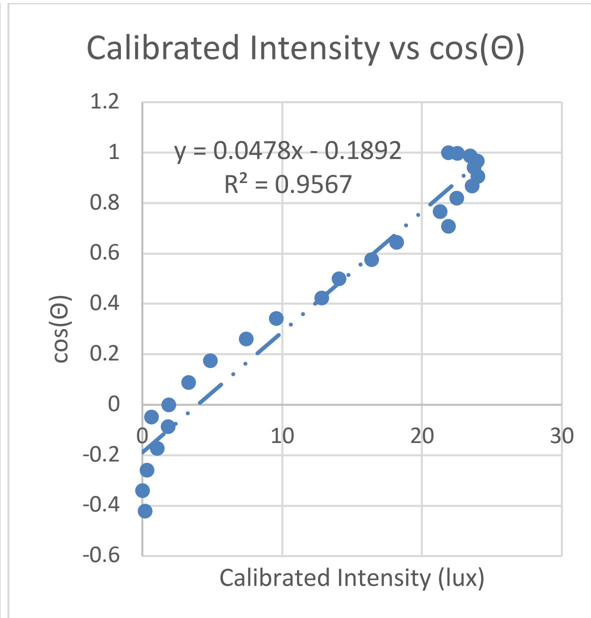
   Background Intensity Reference = 66.8% ± 0.01

3. Complete the following table for all data points collected. The first two columns should be the values collected straight from the equipment (no corrections). The remaining columns should include the corrections for the zero angle offset and the background intensity subtraction.

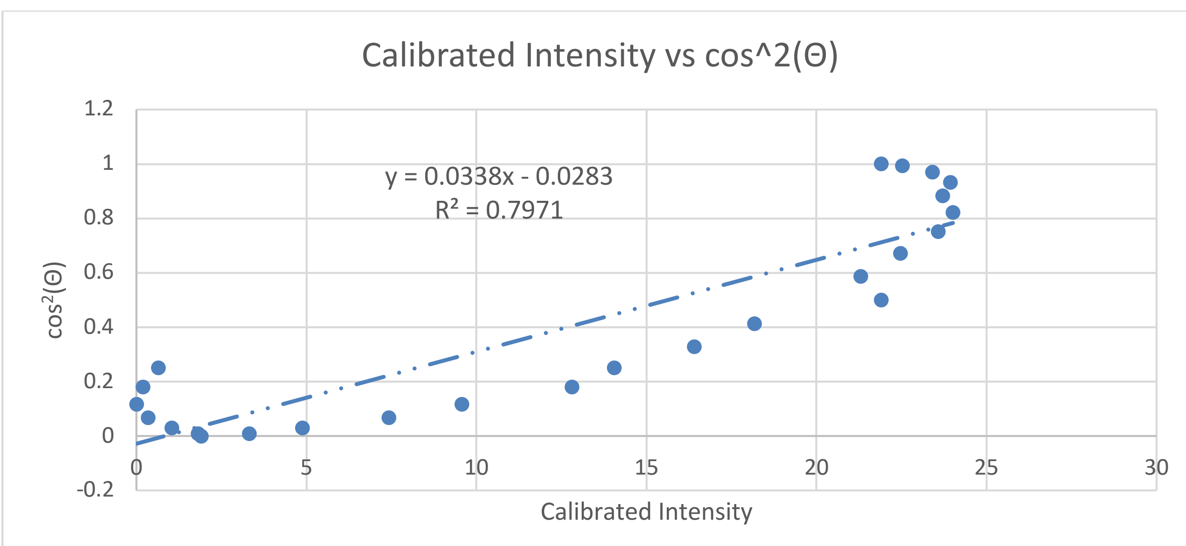
Instrument Angle [deg]	Instrument Intensity [lux]	Angle [deg]	Calibrated Intensity [lux]	$\cos\theta$ [radians]	$\cos^2\theta$ [radians]
90	88.70	0	21.90	1.000	1.000
85	89.32	5	22.52	0.996	0.992
80	90.22	10	23.42	0.985	0.970
75	90.73	15	23.93	0.966	0.933
70	90.52	20	23.72	0.940	0.883
65	90.81	25	24.01	0.906	0.821
60	90.38	30	23.58	0.866	0.750
55	89.26	35	22.46	0.819	0.671
50	88.10	40	21.30	0.766	0.587
45	88.70	45	21.90	0.707	0.500
40	84.97	50	18.17	0.643	0.413
35	83.20	55	16.40	0.574	0.329
30	80.86	60	14.06	0.500	0.250
25	79.61	65	12.81	0.423	0.179
20	76.37	70	9.57	0.342	0.117
15	74.22	75	7.42	0.259	0.067
10	71.68	80	4.88	0.174	0.030
5	70.12	85	3.32	0.087	0.008
0	68.71	90	1.91	0.000	0.000
-5	68.62	95	1.82	-0.087	0.008
-10	67.85	100	1.05	-0.174	0.030
-15	67.14	105	0.34	-0.259	0.067
-20	66.80	110	0.00	-0.342	0.117
-25	66.99	115	0.19	-0.423	0.179
-30	67.44	120	0.64	-.0500	0.250

4. **Produce two plots and include here**: Calibrated Intensity vs Angle, and Calibrated Intensity vs $\cos\theta$. Remember and follow the guidelines for producing good plots. Although we would not expect either plot to be linear from our background physics, include in each plot a linear 'fit' with the equation and R^2 value displayed. Consider making the fit line dashed to indicate it is only preliminary.





5. **Produce one final plot and include here**: Calibrated Intensity vs $\cos^2\theta$. Follow the guidelines for producing good plots. Include in the plot a linear fit with the equation and R^2 value displayed.



6. Of the three different mathematical models fit in the three plots, which one comes closest to truly representing the behavior of unpolarized light after it is transmitted through two linearly polarizing sheets? Note: An R^2 value of 1 would be a perfect linear fit to data.

"Calibrated Intensity vs cos(Θ)" is the closest model to representing unpolarized light, with its R^2 equal to 0.9567.

7. Is your result from (6) what you would expect from the background physics?

   No

8. From what you've learned, what would the intensity be if you transmitted unpolarized light through only a single linearly polarizing sheet? Consider the initial intensity is I_o.

   The intensity should be exactly half of I_0

9. If you have transmitted light through two ideal linearly polarizing sheets when their polarization axes are crossed (rotated 90° to each other) what is the final transmitted intensity?

   0 lux

10. Starting with the situation outlined in (9), you add a 3rd linear polarizer between the other two with its polarization axis at 45° to the first while leaving the other two unchanged. Now what is the final transmitted intensity? Consider the initial intensity is I_o.

    $I = \frac{1}{4} \times I_0$