

Index of Refraction Data

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Setup

Using Snell's Law, we computed the refraction index for liquids through the equation

$$n_2 = \frac{n_1 \sin(\theta_1)}{\sin(\theta_2)} \text{ derived from}$$

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

n_2 is the refraction index for the liquid.

Needed in our report:

- The Equation formatted nicely with L^AT_EX (Anthony or I can help you with that)
- Why we tried soda and not just water or other clearer liquids
- The data collection papers Anthony created.
- Why we used two lasers instead of one
- Some explanation of the code we used to compute the refraction indices and propagate error
- The problems in data collection we encountered (ask Anthony)
- The problems in code we encountered (ask Benjamin)
- What we would have done if we could have collected data the second week

The following measurements use a subscript g or r to denote a measurement from the green laser or the red laser, respectively. Each measurement shone the light first through air into the substance, so a the n_{1g} is the known index of refraction for air (1.000277). We will list during each trial experiment to avoid confusion. We have assumed a $\pm 1 \cdot 10^{-6}$ uncertainty in the refraction index for air.

Mountain Dew

Green Laser

$$\begin{aligned} n_{1g} &= 1.000277 \\ \theta_{1g} &= 30^\circ \\ \theta_{2g} &= 21^\circ \\ n_{2g} &= 1.3956 \\ dn_{1g} &= 1 \cdot 10^{-6} \\ d\theta_{1g} &= 1^\circ \\ d\theta_{2g} &= 1^\circ \\ dn_{2g} &= 4.36591 \end{aligned}$$

Red Laser

$$\begin{aligned} n_{1r} &= 1.000277 \\ \theta_{1r} &= 38^\circ \\ \theta_{2r} &= 27^\circ \\ n_{2r} &= 1.35649 \\ dn_{1r} &= 1 \cdot 10^{-6} \\ d\theta_{1r} &= 1^\circ \\ d\theta_{2r} &= 1^\circ \\ dn_{2r} &= 3.17838 \end{aligned}$$

Diet Mountain Dew

Green Laser

$$\begin{aligned} n_{1g} &= 1.000277 \\ \theta_{1g} &= 30^\circ \\ \theta_{2g} &= 16^\circ \\ n_{2g} &= 1.81448 \\ dn_{1g} &= 1 \cdot 10^{-6} \end{aligned}$$

$$\begin{aligned}
d\theta_{1g} &= 1^\circ \\
d\theta_{2g} &= 1^\circ \\
dn_{2g} &= 7.06531
\end{aligned}$$

Red Laser

$$\begin{aligned}
n_{1r} &= 1.000277 \\
\theta_{1r} &= 37^\circ \\
\theta_{2r} &= 29^\circ \\
n_{2r} &= 1.24169 \\
dn_{1r} &= 1 * 10^{-6} \\
d\theta_{1r} &= 1^\circ \\
d\theta_{2r} &= 1^\circ \\
dn_{2r} &= 2.78083
\end{aligned}$$

Water

Green Laser

$$\begin{aligned}
n_{1g} &= 1.000277 \\
\theta_{1g} &= 22^\circ \\
\theta_{2g} &= 18^\circ \\
n_{2g} &= 1.21259 \\
dn_{1g} &= 1 * 10^{-6} \\
d\theta_{1g} &= 1^\circ \\
d\theta_{2g} &= 1^\circ \\
dn_{2g} &= 2.75429
\end{aligned}$$

Red Laser

$$\begin{aligned}
n_{1r} &= 1.000277 \\
\theta_{1r} &= 42^\circ \\
\theta_{2r} &= 30^\circ \\
n_{2r} &= 1.33863 \\
dn_{1r} &= 1 * 10^{-6} \\
d\theta_{1r} &= 1^\circ \\
d\theta_{2r} &= 1^\circ \\
dn_{2r} &= 2.75429
\end{aligned}$$