THE COLORS OF WHITE LIGHT (REFRACTION AND PRISMS)

Materials:

- Stand-up white paper
- White paper to lay under the prism
- Prism
- White light flashlight
- Black cardstock or stiff paper
- Scissors

Instructions:

1. Set the prism onto its end and on the white paper.

2. Cut a small very thin notch into the stiff black paper. This will shape the light from the flashlight into an image.

3. With the notch down, hold the black paper on edge in the middle of the white paper. Lay the flashlight down on its side, and point the light from the flashlight toward the notch and to the prism on the other side of the black paper.

4. Make sure that there is a well-defined, narrow line of light from the flashlight on the white paper emerging from the black paper and into the prism. Then rotate the prism around its long axis so that the light image reaches one of the faces of the prism at an angle and so that a rainbow of colors emerges from the adjacent prism face.

5. Place a stand-up paper into this colorized beam to better see the separated colors of the flashlight.

7. When the prism is in a position that produces a rainbow color, measure the incident angle of the white light entering the glass prism (relative to a perpendicular line to the side of the prism, see figure).

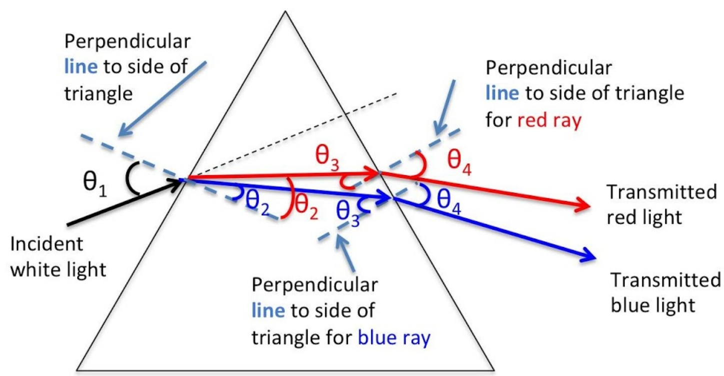
Incident angle of white light (degrees): ________________

8. Using Snell's law, the measured incident angle and the refractive indices, η, of each of the different colors of light entering the glass from the air, calculate the transmitted angle of the red, green, and blue light **entering the glass from the air, enter the glass/air interface on the other side of the prism, and the exiting angle on the other side of the prism**?

Note that the refractive indices of three main colors in glass are: $\eta_{glass,red}$ = 1.50917, $\eta_{glass,green}$=1.51534, and $\eta_{glass,blue}$=1.51690. Assume that the refractive index for all colors of light in air is η_{air} = 1.000.

The table below will help you organize the data and the figure shows the equations that you can use.

Measured incident angle of white light, θ_1 (degrees)	refractive index of light in air	refractive index of color light in glass	color	Calculated transmission angle at air/glass interface, θ_2 (degrees)	Calculated incident angle at glass/air interface, θ_3 (degrees)	Calculated transmission angle at air/glass interface, θ_4 (degrees)	Measured exiting angle of color light, θ_4 (degrees)
	1	1.5169	blue				
	1	1.51534	green				
	1	1.50917	red				



$$\sin\theta_2 = \frac{\eta_1 \sin\theta_1}{\eta_2}$$

Snell's Law

$$\theta_3 = 60 - \theta_2$$

$$\sin\theta_4 = \frac{\eta_3 \sin\theta_3}{\eta_4}$$

Snell's Law

Based on your calculations…

Which color is expected to exit at a larger angle? ______________

Which will exit at the smallest angle? _______________

Are the calculated results consistent with the pattern of colors in the rainbow that you observed experimentally?____________