Experiment 6 Index of Refraction

William Wagner

Alex Yeoh

We used a phet to generate data to calculate the refractive indices of water, glass and a mystery material. The calculated range for the refractive index of water was a little higher than the handbook value while the handbook refractive index of glass fell within the calculated range for the refractive index of glass.

**Results**

The calculated refractive index of water was 1.343124371± 0.009241895 which was slightly above the handbook value of 1.33. The calculated refractive index of glass was 1.541804876± 0.064326094 which contained the handbook value of 1.50.

**Questions for Discussion**

1. For each of the materials (Water and Glass) state whether the index of refraction is in agreement with the accepted value’s index of refraction given in the simulation. Use the range of values for each material’s index of refraction that you calculated in your discussion.

The calculated index of refraction for water was a little higher than the handbook value with the lower end of the calculated range of values for water being 1.333882476. The calculated index of refraction for glass, however, had the handbook value of 1.5 within its range of 1.477478782 to 1.60613097.

1. Mystery A material’s index of refraction is not given in the simulation (else, it would not be a mystery). Look up online for a list of indices of refraction of various materials to determine what material Mystery A is made. Justify your answer using the range of values for the experimentally determined index of refraction for Mystery A. Are there any other materials that have an index of refractions that are close to the material you chose from the online list? If so, list these as possible choices. Discuss why you chose a particular material over other materials that may be close.

Mystery material A is likely to be diamond which has a refractive index of 2.417 which falls within the calculated range of 2.403911046 to 2.471340959. Strontium titanate had a similar refractive index at 2.41 but wasn’t chosen due to it being black while material A was more of a dark purple which diamonds could be.

1. The following is a graph of the Index of Refraction for Water as a function of the wavelength of the light beam used.

In the simulation a “red” laser light is used. Look up what the wavelength of red light is (it is really a range of values, so choose an average value) and compare the index of refraction that you found experimentally for Water to this graph. How well does your value agree with the graph? If you were using a green laser pointer what approximate expected index of refraction would you have?

Red has a wavelength around 675nm, which would yield an index of refraction of approximately 1.332. The experimental refractive index of water was 0.011124371 larger than the refractive index of red light. Green light has a wavelength around 540nm which would yield an index of refraction of approximately 1.336.

1. Visible light ranges from approximately 400 nanometers to 700 nanometers. Using the graph in question 3 and Snell’s Law, determine the angular spread (largest angle to smallest angle) that an incident white light source (starting in Air) being refracted by Water would have.

Minimum: the smallest angle would be an angle that approaches 0˚ but not 0˚ as the light would not be bent at 0˚  
400nm: approximately 1.344, sin-1(1/1.344)= 48.07736171˚  
700nm: approximately 1.332, sin-1(1/1.332)= 48.65545215˚  
The angular spread would be from 48.65545215˚ to just above 0˚