# ISLAMIC UNIVERSITY OF TECHNOLOGY

# PHYSICS LAB REPORT

# Experiment No. 09 Group/Batch No.: 03

# Student No.:

# Course Number: 4142

# Name of the Experiment:

# DETERMINATION OF THE REFRACTIVE INDEX OF A LIQUID BY PLANE MIRROR AND PIN METHOD USING CONVEX LENS

# Date of Performance: 31 January, 2019 Name:

# Date of Submission: 14 February, 2019 Department: C.S.E.

# Section:

Partner’s ID No.:

Theory: If a convex lens is placed on a few drops of liquid on a plane mirror and pressed down, the liquid is squeezed in the space between the mirror and the lens, thus forming a Plano-Concave liquid lens. The curved surface of this liquid lens has the same radius of curvature as the original lens, thus giving a combined lens and liquid, which acts as a convergent lens. The focal length of this combination is:

- (i)

where and are the focal lengths of the convex lens and the liquid lens respectively.

Correcting equation (i) to account for the negative ,

- (ii)

can this be determined by finding and experimentally.

can also be determined by the following equation:

or,

- (iii)

where is the refractive index of the liquid.

Thus, if , the radius of curvature of the lower surface of the convex lens, and can be determined, can be found.

Apparatus: Convex Lens, Plane Mirror, Pin with Tip Painted, Spherometer, Slide Callipers, Stand and Liquid

Procedure:

Determination of the focal length, , of the convex lens:

This can be done using the ‘pin method’. A pin, , was placed at the principle focus of the convex lens, , placed on a mirror, . The rays that passed through the lens were parallel, thus forming an image, , just next to the pin. The height of the pin was adjusted so the image was the same size as the pin, and small adjustments were made to avoid parallax errors. The distance, , between the tip of the lens and pin was measured, and the focal length was measured using the equation where is the thickness of the lens. This was done a few times and a mean result was taken.

Determination of the focal length of the combination:

A few drops of liquid were placed beneath the lens and squeezed between the lens and mirror. The same steps that were followed to determine the focal length of the convex lens were repeated to find the focal length of the combination, .

Measurement of the radius of curvature of the surface of the lens in contact with the liquid:

It was ensured that the lens was dry. A spherometer was taken and the smallest division on the vertical scale found. To do this, the screw was rotated and the distance the disc moved was found (pitch). Pitch was divided by the number of divisions in the circular scale to find the least count. In the next step, the spherometer was placed on the glass plate and the screw slowly turned until the central leg just touched the base. The main scale and linear scale readings were taken three times and the average results tabulated. This was also done with the spherometer on the lens surface that was in contact with the liquid. The difference between the two values, , was found. Lastly, the spherometer was pressed lightly onto a piece of paper, so the three legs make indentations. The linear distance between the legs was found using a rule, and the mean value, , was recorded. Now the radius of curvature of the lens was found by the equation .

Data Collection:

Measurement of :

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reading on | Obs. No. | Linear Scale Reading | Circular Scale Divisions | Least Count | Fractional Reading | Total | Mean |
|  |  |  |  |  |  |
| Base Plate | 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| Lens Surface | 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |

Reading on lens surface Reading on base plate

Measurement of :

Mean value of

Thickness of lens,

Determination of Focal Length:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Obs. No. | Distance Between pin and face of lens without liquid () | Focal Length of Convex Lens | M  E  A  N | Distance between pin and top surface of lens with liquid  () | Focal Length of Combination | M  E  A  N | Focal Length of liquid lens |
| 1 |  |  |  |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |

Calculation:

Error Analysis:

Percentage Error

Discussions:

1. Determination of whether the image of the pin was the same size as the object was done by eye. This was both difficult to do, especially after adding the liquid (glycerine), and likely to cause large human errors.
2. It was difficult to ensure all the legs of the spherometer were in contact with the surface of the lens.
3. Multiple readings were taken at every step and the mean values used in calculations to try and reduce the effect of errors.