



**EXERCISE
81A**

**DETERMINATION OF RADIUS OF CURVATURE OF THE
LENS AND THE WAVELENGTH OF LIGHT USING THE
NEWTON'S RINGS**

Measurement procedure

1. List of equipment

- traveling microscope
- interference filters
- plano-convex lens
- flat glass plate

2. Goals

- Investigation of Newton's rings – light interference in optical wedge
- Determination of radius of curvature of the lens
- Determination of the wavelength of light

3. Measurement setup

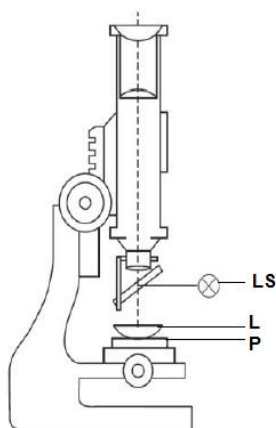


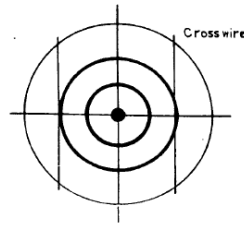
Fig. 1. A scheme of the measurement equipment: **LS** – light source, **L** – plano-convex lens, **P** – flat glass plate.

4. Measurements plan

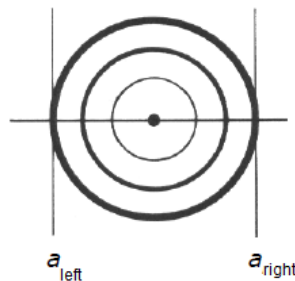
Determination of radius of curvature of the lens

- a) Carefully clean and dry the surface of a flat glass plate and an investigated lens.
- b) Put the flat plate on the microscope stage. Put the investigated lens on top of it, with the convex side down (the flat side is marked). The middle of the lens should be directly below the microscope objective.
- c) Mount an interference filter of a known wavelength on the microscope's illuminator and turn the illuminator on. Adjust the beam splitter plate so that the light reflected off the flat plate is collected by the microscope.
- d) Adjust the distance of the microscope objective from the lens. A spot with rings can be seen when the microscope is properly focused.

- e) Adjust the centre of the crosswires at the centre of the rings pattern (see schematic figure below).



- f) Move the microscope to the left of the chosen dark ring and adjust the crosswire tangentially in the middle of it. Note down the reading of the micrometer screw a_{left} (see figure below). **Repeat 6 times.**
- g) Move the microscope to the right of the same dark ring and adjust the crosswire tangentially in the middle of it. Note down the reading of micrometer screw a_{right} (see figure below). **Repeat 6 times.**



- h) Repeat the measurements described in f) and g) for **three** chosen Newton's rings of higher orders.

Note! Select the rings of higher order – for example beginning from the 6th ring

Determination of the wavelength of light

- Mount an interference filter of unknown wavelength on the microscope's illuminator.
- Perform all the measurements in the same way as previously.

5. Analysis of results

Determination of radius of curvature of the lens

- Determine the radius r of each ring using the following formula:

$$r = 0.5 \cdot |a_{right} - a_{left}|$$

- Calculate the mean value of the radius of the selected Newton's ring \bar{r} using the formula:

$$\bar{r} = \frac{r_1 + r_2 + \dots + r_6}{6}$$

- Calculate the radius of curvature of the test lens using the following the expression:

$$R = \frac{\bar{r}^2}{m\lambda}$$

where λ is the wavelength labeled on the used interference filter. Repeat for all the chosen Newton's rings.

- d) Calculate the mean value of the radius of curvature of the lens \bar{R} using the formula:

$$\bar{R} = \frac{R_1 + \dots + R_3}{3}.$$

- e) Calculate the uncertainties of all the determined quantities.

Determination of the wavelength of light

- a) Determine the radius r of each ring using the following formula:

$$r = 0.5 \cdot |a_{right} - a_{left}|$$

- b) Calculate the mean value of the radius of the selected Newton's ring \bar{r} using the formula:

$$\bar{r} = \frac{r_1 + r_2 + \dots + r_6}{6}$$

- c) Calculate the unknown wavelength of the filter using the following the expression:

$$\lambda = \frac{\bar{r}^2}{m\bar{R}}$$

where \bar{R} - radius of curvature of the test lens, determined earlier. Do the same calculations for all the chosen Newton's rings.

- d) Calculate the mean value of the wavelength of the filter using the formula:

$$\bar{\lambda} = \frac{\lambda_1 + \dots + \lambda_3}{3}.$$

- f) Calculate the uncertainties of all the determined quantities.

6. Proposed result table (for teacher approval)

order of the ring	a_{right} [mm]	a_{left} [mm]
m = 6		
e.g. m = 8		
e.g. m = 9		