EXPERIMENT 1: Polarized Light

General Information

Equipment:

- one electric tungsten bulb made of frosedt-surface glass complete with mounting stand, 1 set
- 3 wooden clamps, each of which contains a slit for light experiment
- 2 glass plates; one of which is rectangular and the other one is square-shaped
- 1 polaroid sheet (circular-shaped)
- 1 red film or filter
- 1 roll self adhesive tape
- 6 pieces of self-adhesive labelling tape
- 1 cellophane sheet
- 1 sheet of black paper
- 1 drawing triangle with a handle
- 1 unerasable luminocolour pen 312, extra fine and black colour
- 1 lead pencil type F
- 1 lead pencil type H
- 1 pencil sharpener
- 1 eraser
- 1 pair of scissors

Important Instructions to be Followed

1. There are 4 pieces of labelling tape coded for each contestant. Stick the tape one each on the instrument marked with the sign #. Having done this, the contestant may proceed to perform the experiment to answer the questions.
2. Cutting, etching, scraping or folding the polaroid is strictly forbidden.
3. If marking is to be made on the polaroid, use the lumino-colour pen provided and put the cap back in place after finishing.
4. When marking is to be made on white paper sheet, use the white tape.
5. Use lead pencils to draw or sketch a graph.
6. Black paper may be cut into pieces for use in the experiment, but the best way of using the black paper is to roll it into a cylinder as to form a shield around the electric bulb. An aperture of proper size may be cut into the side of the cylinder to form an outlet for light used in the experiment.
7. Red piece of paper is to be folded to form a double layer.

The following four questions will be answered by performing the experiment:

Questions

1.1

1.1.a
Locate the axis of the light transmission of the polaroid film. This may be done by

observing light reflected from the surface of the rectangular glass plate provided. (Light transmitting axis is the direction of vibration of the electric field vector of light wave transmitted through the polaroid). Draw a straight line along the light transmission axis as exactly as possible on the polaroid film. (#)

1.1.b
Set up the apparatus on the graph paper for the experiment to determine the refractive index of the glass plate for white light.

When unpolarized light is reflected at the glass plate, reflected light is partially polarized. Polarization of the reflected light is a maximum if the tangens of incident angle is equal to the refractive index of the glass plate, or: $\tan \alpha = n$.
Draw lines or dots that are related to the determination of the refractive index on the graph paper. (#)

1.2

Assemble a polariscope to observe birefringence in birefringent glass plate when light is normally incident on the plastic sheet and the glass plates.

A birefringent object is the object which splits light into two components, with the electric field vectors of the two components perpendicular to each other. The two directions of the electric field vectors are known as birefringent axes characteristic of birefringent material. These two components of light travel with different velocity.

Draw a simple sketch depicting design and functions of the polariscope assembled.

Insert a sheet of clear cellophane in the path of light in the polariscope. Draw lines to indicate birefringent axes (#). Comment briefly but concisely on what is observed, and describe how berefringent axes are located.

1.3

1.3.a
Stick 10 layers of self-adhesive tape provided on the glass plate as shown below. Make sure that each layer recedes in equal steps.

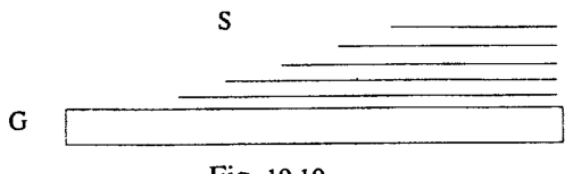


Fig. 19.10

G square glass plate as a substrate for the cellophane layers
T 10 layers of cellophane sheet
S steps about 3 mm up to 4 mm wide

Insert the assembled square plate into the path of light in the polariscope. Describe conditions for observing colours. How can these colours be changed ? Comment on the observations from this experiment.

1.3.b
Prepare monochromatic red light by placing doubly-folded red plastic sheet in the path of white light. Mark on the assembled square plate to show the steps which allow the determination of the difference of the optical paths of the two components of light from berefringent phenomenon, described under 1.2 (#).
Estimate the difference of the optical paths from two consecutive steps.

1.4

1.4.a
With the polariscope assembled, examine the central part of the drawing triangle provided. Describe relevant optical properties of the drawing triangle pertaining to birefringence.

1.4.b
Comment on the results observed. Draw conclusions about the physical properties of the material of which the triangle is made.

Additional Cautions

Be sure that the following items affixed with the coded labels provided accompany the report.

1. (#) Polarized film with the position of the transmission axis clearly marked.
2. (#) Graph paper with lines and dots denoting experimental setup for determining refractive index.
3. (#) Sheet of cellophane paper with marking indicating the positions of birefringent axis.
4. (#) Square glass plate affixed with self-adhesive tape with markings to indicate the positions of birefringent axis.